Municipal Circular Land Tenders
How do they affect real estate developers?

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‘‘Anyone who believes in indefinite growth on a physically finite planet is either mad, or an economist.’’ – *Kenneth Boulding*

Preface

When I was a child, I used to play a lot with wooden building blocks. I would stack them up and play with my newly designed building. When we had guests coming over, my building usually had to be removed. Until the next day, when the blocks were used for a new building. It was a process which repeated itself sometimes several times a week.

The joy I had by playing with these blocks and designing something new every day was one of my reasons to study architecture. This graduation thesis marks the end of my study at architecture. In the project itself, I wanted to combine the public and private interests of building a city. The process of how we build a world to live, work, study and entertain ourselves still fascinates me. I believe that steering on quality becomes increasingly important in this process. The global population will continue to grow, so will the cities we live in. The only way to make this a success is by building green buildings which contribute to the overall wellbeing.

Although the writing of a graduation thesis is something which you are merely responsible by yourself, I did receive a great amount of support. I want to thank my supervisors from the TU Delft, Ellen and Peter. You did not only reflect on my findings but were also available for brainstorms during our meetings, which I very much enjoyed. Also, Madelon and Peter from Fakton, you were the ones who interested me for the circular economy at the start of my thesis. During the writing of my thesis you supported me in delivering a graduation research which is applicable in practice. Additionally, I am very thankful to everyone who was willing to be interviewed for my thesis. I had so many inspiring interviews, some of which lasted for more than three hours.

Last but not least, I am very thankful for all the people I have met during my studies. You made studying so much more fun than just studying. It was a time where I was able to take opportunities, I would not have imagined beforehand. Two of the people I encountered during my studies I would like to thank, not in the least because they brought meaningful contributions to my graduation. Koen, I enjoyed our study sessions and skype meetings, where we could discuss literature which was relevant for both our graduation studies, or how you should contact an interviewee. Last but not least, I want to thank Julia. You did not only help me to improve my English writing, you helped me a lot in those times when I just needed a shoulder to lean on.

This thesis marks the end of my graduation, a year in which I was able to take a deep dive in the subjects of land tendering and the circular economy. I enjoyed studying this subject and hope you will enjoy reading my thesis. Please do not hesitate to contact me if you want to discuss it.

Summary

Glossary

BREEAM	'Building Research Establishment Environmental Assessment Method'. Method to assess and certify the sustainability in buildings.
Circular Economy (CE):	Strategy that emerges to oppose the traditional open-ended system, aiming to face the challenge of resource scarcity and waste disposal in a win-win approach with economic and value perspective.
Circular public procurement (CPP)	The procurement of competitively priced products, services or systems that lead to extended lifespan, value retention and/or remarkably improved and non-risky cycling of biological or technical materials, compared to other solutions for a similar purpose on the market.
EPC	'Energie Prestatie Coëfficient' (energy performance coefficient). Method to calculate the energy consumption of buildings.
Land tendering	The act where a government sells land to a market party, using tender allocation to select a party for the development.
Material passport:	A database which includes information from all used materials in a building, including their characteristics. This gives the used materials value for recovering, recycling and reusing.
MPG:	'Milieu Prestatie Gebouwen' (environmental performance of buildings). Score to calculate the environmental footprint of all construction materials in a building.
Public procurement	The act where a government purchases a good or service from the market.
Sustainable public procurement (SPP)	Procurement method where quality related criteria are incorporated in the assessment, to stimulate tenderers to pursue environmental and social sustainability goals.
Tender request:	Question put out by the procuring party (in this thesis, the municipality).
Tender proposal:	Response from tenderer to the tender request.
Tenderer:	Party which sends a tender proposal.

Summary

Problem statement

Many countries have committed themselves to a carbon neutral target in 2050. To reach this target, actions in the field of energy and the materials we use must be taken (Ellen MacArthur, 2019). Regarding this last theme, the European Union and the Dutch government have committed themselves, among others, to a policy for a circular economy (CE). They both aim to be completely circular in 2050 (European Commission, 2015; Rijksoverheid, 2016). In this transition, the construction sector is an important sector. Activities regarding the construction industry account for half of the consumption of all virgin materials in the Netherlands and around 2/3 of all waste production in Europe (Rijksoverheid, 2018b; European Commission, 2016). This thesis describes the current state of Dutch municipal circular building policy and the implementation of these policies in municipal land tendering. An answer is given to the research question:

''How can tender requests be improved to pursue municipal circular building goals in land tendering?''

Research Method

The thesis is conducted in the three parts visualised in *figure 1*. First, a literature study is conducted. The aim of this literature study is to lay a theoretical fouccation on the subjects of circular economy and land tendering. This is done by exploring the most influential literature regarding a CE. In addition, several CE models are described and circular cities are brought into focus. Subsequently, the theme of land tendering is explored. This theme will eventually narrow down to how the CE can be implemented through land tendering.

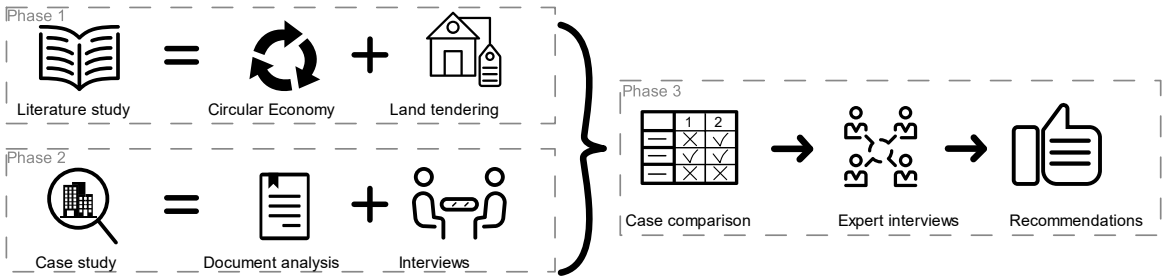


Figure 1: Research design

In the second phase, four case studies are conducted. These case studies are conducted on three levels: the circular land tendering policy, the tender request and the tender proposal. The tender documents are studied, both from the tender request and the tender proposal. This is complemented with interviews that are conducted with both, the municipal and the developer side. The aim of these case studies is to get an understanding in the current practices regarding circular land tendering.

The last phase is concerned with providing recommendations regarding circular land tendering. By comparing the findings from the four different cases, common mismatches in the tendering process can be detected. Recommendations to overcome these mismatches are designed, which are verified and refined in a set of expert interviews. This is a set of seven interviews, mainly with consultants who have experience in implementing circular criteria in land tendering. The result of this phase is a tender process, which is verified and refined, on how circularity can be implemented to pursue circularity in land tendering. Additionally, criteria to pursue circular goals in a tender process are designed.

Theoretical framework
Two relevant themes for answering the research question are explored: the circular economy and land tendering. Both these aspects are combined to understand the available theory of implementing CE aspects in land tendering.

Circular Economy
Many definitions of a CE were found. Most of them recognise two aspects in a CE: environmental and economic. Environmental aspects aim to reduce environmental harm by minimising material use. Economic aspects focus more on the implementation, by limiting material use with new business models such as sharing and reusing materials. A common factor of the CE aspects, as well as many definitions, is that they recognise reusing and recycling as core principles of a circular economy. Even though there is not one right or wrong definition of a CE, a comprehensive definition is found: "CE is a strategy that emerges to oppose the traditional open-ended system, aiming to face the challenge of resource scarcity and waste disposal in a win-win approach with economic and value perspective." (Homrich, Galvão, Abadia, & Carvalho, 2018, p. 534).

Like the various definitions of a CE, there is a wide range of models on how the CE should be implemented. The different models incorporate different aspects of a CE. Narrow models focus on the material aspects of a CE, for example in reducing, reusing and recycling. For these narrow models, the aim is to use as little materials and processing as possible. More elaborate models incorporate also other aspects. For example, the seven pillars model by Gladek (2019) and the Doughnut economy by Raworth (2012) both include social aspects. These state that a CE can only function if social needs are fulfilled. More specific is the model from Williams (2019a), who defines three core aims for a circular city (the first three), complemented with four supporting aims. In this model, a city must stimulate:

- Looping: Reusing materials within the city to minimise virgin material use.
- Adapting: Buildings can adapt to a changing demand.
- Regeneration: Producing energy and regenerate eco-systems in a city.
- Localise: Use locally produced goods and services, to keep positive and negative externalities of production also local.
- Sharing: Sharing products and facilities can lower the demand, leading to a lower material consumption
- Optimising: Optimising the water & energy use, to lower the consumption.

This model shows that a city should facilitate circular behaviour from all activities in a city. Therefore, a tender request should target these aims to construct buildings which facilitate circular activities in the city.

Land tendering
Land tendering is the act where a government sells land to a market party, using tender allocation to select a party for the development. Pursuing policy goals through public procurement is seen as an effective strategy because public procurement accounts for 20% of the GDP in the Netherlands. In the construction sector this share is even larger, leading to a high influence of governmental procurement on the industry. Consequently, the incorporation of quality aspects in tender assessment is increasing. One of these quality aspects can be the CE value of the building that will be built on the land, although it has been found that experience with circularity in tender processes is limited.

The amount of literature on land tendering is limited, therefore the subject is broadened to public procurement. The general concepts of selecting a party through tender allocation can be interpreted as being analogous to public procurement towards land tendering. Literature shows that circularity must be incorporated throughout the tendering process, from the preparation up until constructing and using the building. In the preparation

phase, the procuring party must be aware about what they want to procure. A CE policy which is translated into project specific goals helps to define the CE ambitions in the tender. In the next tender steps, these goals must be translated into tender criteria. These criteria measure the circular value of the proposals. Therefore, the criteria must measure the circular result, but must also be enforceable when the tender has been awarded. The enforceability of a criterion will ensure that something which is promised, can be checked upon realisation.

Case studies

The aim of the case studies is to gain insight into the current state of circular land tendering in the Netherlands, to understand potential problems and successes which might occur. Therefore, cases are studied on three levels: the relevant circular building policy, the tender request, and the tender proposal. By comparing these three levels, it can be studied how circular goals move through the tendering process. The hypothesis is that circular goals are mainly derived from policy. These are ten translated into tender goals, and finally translated again by the tenderer into a tender proposal. All four cases, which are listed in *table 1*, are compared with each other based on their circular specifications (further elaborated from page 37).

Table 1: Overview of the cases studied

	Amsterdam: Kop Zuidas	Amsterdam: Kavel 14-01	Rotterdam: Delftseplein	Utrecht: Healthy Urban Quartier (HUQ)
				
Max floor area	24.000 m^2	7.500 m^2	41.000 m^2	70.000 M^2
Functions	- Offices - Amenities - Housing - Parking	- Housing - Amenities (social, offices) - Parking	- Housing - Offices - Hotel possibility - Sharing facilities	- Housing - Commercial - Cultural functions
Weight criteria	15% sustainability	40 – 50% circularity	30% sustainability	~ 10% sustainability
Circular criteria	Part of sustainability Make specific, BREEAM certificate	GPR & MPG score and qualitative justification	Part of sustainability, BREEAM certificate specified	Part of sustainability, contribution to CE

<u>Circular land tendering policy</u>

Of the studied cases, the municipality of Amsterdam was the only municipality which had a policy specifically targeted at circular land tendering. This policy is not incorporated in the case of Kop Zuidas because the process of formulating the tender criteria was too advanced when the policy became available. The case of Kavel 14-01 was the first project where the policy was used. In this project it was found that the 'roadmap circular land tendering' offered specific criteria and goals to incorporate circularity in a land tender.

However, these criteria and goals were so specific that it was difficult to directly incorporate them into the tender request. Therefore, the policy was used as a guideline and a new process was initiated to formulate the tender request.

For the cases in Rotterdam and Utrecht, there was no circular land tendering policy available, but circularity was incorporated because municipal officials were enthusiastic about it. As a result, these officials had more freedom in the incorporation and were able to define the criteria as they considered the most appropriate. The absence of circular land tendering policy makes the implementation of circular goals more dependent on officials. Additionally, municipal officials are only able to incorporate circularity when it is supported by their superiors. Therefore, in the municipalities where no policy was available during the tender, a need has occurred for circular building policy, also from the managerial level.

Tender requests

The criteria listed in *table 1* already show that circularity is incorporated differently in each tender request. The case of Kavel 14-01 is the only one where circularity was assessed separately in the other cases it was assessed as part of sustainability. For the circularity criteria of Kavel 14-01, tenderers were required to deliver a circularity vision. Subsequently, in the second tender phase, tenderers had to include a GPR and MPG score in their proposal, together with a qualitative substantiation. A GPR score assesses proposals on five sustainability aspects, with a focus on materials and energy. An MPG score requires tenderers to calculate the environmental footprint of the materials they use in their building. However, the limited availability of information regarding materials during the tender phase, makes that tenderers based these calculations mainly on assumptions. Criteria which require less information can help to assess tender proposals on more objective information.

In the other cases, circularity was requested as part of sustainability. Here, the request for circularity is less specific in the criteria than for the case of Kavel 14-01. In these cases, tenderers were required to include a vision on circularity in their proposal. Depending on the ambitions of the tender request. This vision had to include specific aspects. In addition to this vision, a BREEAM certificate was required to score on sustainability for two of the tenders. This certificate scores buildings based on the sustainability measures. It incorporates many different sustainability aspects and is widely known and used in the construction industry, which was also one of the reasons to include the certificate. In the case of Healthy Urban Quartier (HUQ), the municipality explicitly chose not to include a BREEAM certificate. Due to the fact that BREEAM scores specific measures, it was believed this does not lead to an intrinsic better building but stimulates tenderers to only take these specific measures. The omission of these certificates has also led to different sustainability measures in this building. These could be taken because other, certificate related measures, were not taken.

Tender proposals

The extent of circularity varied in the tender proposals in the same manner as the extent of circularity varies in the different tender requests. In the case of Kavel 14-01, where the assessment weight for circularity was 40 – 50%, the focus on circularity in the tender was the reason for the developer to participate in the tender. This resulted in a project team that was put together on the subject of circular building. In the other tenders, developers participated because they were assessed in general on quality, such as architectural quality, programme, and sustainability. In all studied cases, consultants were hired to incorporate the circular criteria in the proposal.

Although in the cases studied, each real estate developer responded differently to tender requests, their general motives for participation were similar. A developer participates in a tender to win, with a building which suffices the municipalities needs and has a suitable business case. Therefore, developers want to score as high as possible on the tender criteria. Municipalities can have the largest influence on the proposals by the way they formulate and assess the tender criteria. Developers want to fulfil the demands from these criteria as well as possible to win the tender. They invest most of their time and money in the criteria with the highest weight. To have sufficient influence on the design, a criterion weight of 30% is advised. This ensures that developers will hire consultants to incorporate the aspect, influencing the design from the start. Overall, the higher the weight of the criterion, the more influence the aspect, or the consultants responsible for the aspect, will have on the design.

Current state of circular land tendering

By comparing the four case studies, it can be concluded that the amount of circular land tendering policy is limited. In the absence of policy, motivated officials can play an important role in incorporating circular goals in land tendering. Officials would be strengthened by more CE land tendering policy since this will give guidelines for implementation and helps to put circularity on the agenda.

When circularity is incorporated in land tendering, this is mostly done as part of the sustainability goal. It is advisable to make a specific goal for circularity, to prevent that circularity measures get lost in the better-known sustainability measures. Circular goals must be translated into circular tender criteria since tender criteria have the most influence on tenderers. Criteria should measure the circular goal, be flexible to allow for changes in the design phase and be based on the information which is available in the tender phase. Criteria which provide to all these requirements to the full extent have not been found in the cases. Therefore, the development of circular tender criteria deserves attention.

Improvements for land tendering

As a response to the identified challenges in current circular land tendering, two sets of improvements are suggested. The first is a process design, describing the steps where circularity must be present in the tender process. The second is a set of tender criteria, which can be used to incorporate the circular goals of material looping and adaptivity.

Circular land tender process

To improve the inclusion of circularity in future land tendering, figure 2 presents the circular land tendering process design. The process shows the six steps which must be taken in each tender process. This is a deviation from a normal tender process. In the circular land tendering process, more emphasize is placed in the first (preparatory) phases. For the formulation of CE goals, these extra process steps are necessary. Each step will shortly be discussed in the next sections.

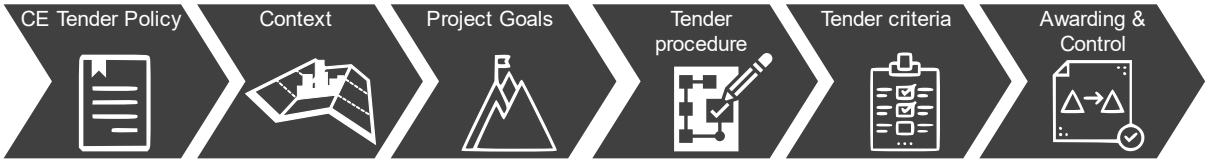


Figure 2: Circular tender process design

The first step is the CE tender policy. A municipality must set policy in place regarding circular land tendering. This policy serves 3 goals:

- Defining the circular economy: A choice must be made from the many definitions of a CE, to precisely formulate what the municipality means with a CE. This helps the municipality and tenderers to reach the policy goals.
- Setting the long-term goals: To understand what goal must be achieved as result of the policy.
- Making an implementation plan: Deliver guidelines on how the policy must be translated into land tenders and assign responsibilities for execution. Officials must be able to understand what the consequences of the policy are for a specific land tender.

These three aims do not necessarily have to be in one document, but all must be present on a policy level. Goals for circular land tendering can be incorporated in circular building policy or land tendering policy, as long as the goals of circular land tendering and their implementation become clear from this policy. The policy will be written once and studied for each tender process. As an outcome of this study, guidelines must be identified on which goals must be pursued in the tender.

The second process step is a study towards the context of the building plot. The context of a building plot is defined by the available infrastructure, adjacent buildings, etc. It is important to understand the challenges and opportunities of the context, to determine which question must be answered by the tender. For example, if a building can be connected to a heat source, or must provide its own heat, if there is a problem with peak rainfall which can be solved on the plot, or if traffic congestion is a problem, which must be tackled with a mobility plan.

The previous steps required investigations to information which must in incorporated in the tender. In the step of defining the project goals, this information must be translated into three or four project goals. Too many project goals will result in a diffuse tender. This will create tender proposals which do a bit of everything, but do not excel in anything and are more difficult to assess. Moreover, a number of three to four goals leads to a weight per goal of around 30%, which is necessary for real estate developers to invest time and money in incorporating design changes from the beginning. When three to four goals are incorporated, the tenderer will generally have time and money to invest in all these goals.

The fourth step is determining a tender procedure that will follow. The most important aspect in this step is that a tender procedure is chosen where a dialogue is included. The circular economy is a multi-faceted subject which is still in development. Tenderers must be able to explain the choices they made, and municipalities must be able to verify if these choices provide an answer to the project goals.

Once a tender procedure is selected, the previously defined goals must be translated into tender criteria. These criteria must assess the tenders based on to what extent they meet the goals. This applies to all tender processes, for the incorporation of CE criteria some extra attention is necessary. The criteria must be enforceable during the construction and use phase of the building to ensure compliance. Quantitative scoring methods such as the EPC and MPG measure the energy production and consumptions, respectively the environmental footprint of the materials. These two methods are the best in meet the requirements of goal measurement and enforceability. The quantitative score can be compared, and they measure the result (energy use or material impact) instead of specific measures. However, mainly in the MPG criterion problems arise regarding the limited amount of information in the tender phase. Developers must make a large amount of assumptions to deliver an MPG score, which will lead to less accurate tender proposals. A tender criterion to quantitatively assess circularity based on less information can help to overcome this problem.

In the last phase of the process the tender is awarded, and the tender proposal must be enforced with a contract. The contract guarantees that agreements can be enforced, it is therefore important that all defined goals and the proposals response are incorporated in the contract. Furthermore, the contract must also be seen as a transfer document. At this point, the further process of developing and building will often be transferred to a different project team, who must also understand the previously agreements.

Circular materials tender criteria

The second set of recommendations consists of a number of tender criteria, which can be incorporated in the tender to pursue the goals of circular materials or adaptive building. These latter are two of the three core aims of a circular city, as defined by Williams (2019a). By addressing these aims in criteria used in a tender, municipalities can stimulate tenderers to come up with proposals to achieve these aims. An example of how each of the criteria could be formulated and included in a tender process is described below. The examples are based on a literature exploration and interviews with experts. Firstly, a criterion to request circular materials in a tender is discussed. Figure 3 illustrates that circular material goals are defined as a project goal and their translation into a tender criterion. The aim here is to define a tender criterion which can measure and enforce this goal.

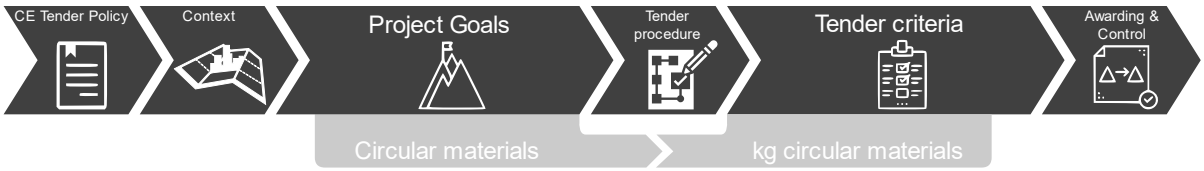


Figure 3: Circular materials goal translated into tender criteria

In the case studies, this was requested by an MPG score or BREEAM certificate. Remarks on the MPG score are that it requires too much information in a tender phase. Detailed information of every construction material is necessary to calculate the score. In addition, innovation is hampered because information is retrieved from a database which only includes materials that have been extensively tested. Remarks on the use of a BREEAM certificate are that it prescribes building measures, while it would be better to assess the result of these measures. When only the result is assessed, tenderers are free to be more creative regarding the measures they take to achieve this result. Based on these remarks, and the findings from the case studies, five requirements for a circular building criterion are defined. The criterion must be:

- Effective: An output requirement is scored based on the effect, without prescribing any measures.
- Enforceable: A score that can be adopted in the contract and enforced by the municipality during the development.
- Flexible: Making it possible for the tenderer to further develop the building after having been awarded the tender.
- Innovative: Making it possible to use innovative materials, which have not gone through extensive testing yet.
- Proportionate: It must be feasible for tenderers to work out the criterion in the tender phase without making too many assumptions or costs.

Based on these requirements a criterion has been formulated which assesses all the building materials based on the R-ladder. The criterion is defined in table 2 based on the four circular steps R1 – R4 which can be taken for materials. The weight of materials for which the step is taken, is multiplied by a predefined factor. This factor is predefined by the municipality and can change per tender depending on the context. A higher factor will give more urgency to the aspect. The multiplication of the weight of the R-steps times the

factor will result in a criterion score which assesses the circular material value of different tender proposals.

Table 2: Circular materials input criterion

R	Definition	Circular steps	*Factor	
R1	Reduce	Amount materials less than reference building (kg)	F1	1,0
R2		Amount of bio-based materials used in building (kg)	F2	0,6
R3	Re-use	Elements / Components reused in building (kg)	F3	0,7
R4	Recycle	Recycled materials reused in building (kg)	F4	0,5
Score = $\frac{(\mathbf{R1} * \mathbf{F1}) + (\mathbf{R2} * \mathbf{F2}) + (\mathbf{R3} * \mathbf{F3}) + (\mathbf{R4} * \mathbf{F4})}{m^2\ \mathbf{BVO}}$				
* *Illustrative factors are given, these can vary per tender*				

For the implementation of the criterion defined by the score in table 2, it is necessary that some aspects are clearly defined. Paragraph 6.2.4 discusses what must be defined for the implementation. With the circular materials input criterion, more information is requested from tenderers than in most tenders. This requires from tenderers to move beyond what they are currently used to. This may result to inaccurate calculations by the first implementations, but when tenderers gain more experience, more accurate calculations can be made. Therefore, all experts perceived the criterion as feasible to request in a tender. However, it is important to study per tender if the requested amount of information can be achieved.

The criterion score only measures the circular value of the materials that are used to construct the building: the input value. Several experts point out that the circular value of how materials can be reused when they become obsolete in the building, the future value, is more important. The technique of table 2 can also be applied to measure this future value. However, the future value is susceptible to more uncertainty, which makes a criterion for the future value less reliable.

<u>Adaptive building tender criteria</u>
The second goal for which a tender criterion is designed is the adaptivity of a building. This is defined as the capacity of a building to accommodate a changing demand. Figure 4 illustrates that in this case adaptive building is defined as project goal and it is translated into tender criteria. Three tender criteria options are defined, which are discussed with a panel of experts.

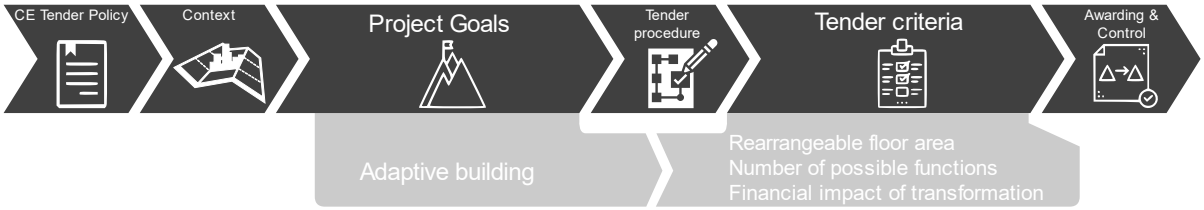


Figure 4: Circular materials goal translated into tender criteria

Two assessment methods for adaptive building are already available: Flex4.0 and BREEAM. These methods both assess the adaptivity of a building based on the free floor space, installation capacity, and modularity of building components. Since these measures are mainly related to the structural concept of the building, most of these can be requested in a tender phase. Three different categories of tender criteria were thought of:

- Rearrangeable floor area
- Number possible of functions
- Financial impact of transformation

The first two assess the technical aspects of adaptivity, based on the measurement techniques of Flex 4.0 and BREEAM. Experts found these criteria suitable for incorporation in a tender, some of them had worked with similar criteria. Based on this, it can be concluded that adaptivity can be quantitatively assessed by requesting the rearrangeable floor area or a potential number of functions. The definition of rearrangeable floor area or a function must be clearly defined in these cases. Municipalities must predefine this in a set of guidelines.

The final criterion for an adaptive building is the financial impact. This criterion is based on a currently often used criterion to request a financial bid in land tendering. By adding a secondary function, with transformation costs, new rent revenues, and new operating costs, an overview of the financial impact can be given. Requesting this in a tender will force tenderers to think about a potential future use of the building. Overall, experts were enthusiastic about a criterion which measures the financial impact of transformation. However, there is no experience yet with requesting the financial impact of adaptivity in a tender. Therefore, the criterion for financial adaptivity must be regarded as a prospect which must be worked out in further research.

Conclusion

This thesis aims to improve municipal circular land tendering. This is done by answering the research question: "How can tender requests be improved to pursue municipal circular building goals in land tendering?"

It can be concluded that the circular economy field is rapidly evolving: there are many definitions and models available on a CE. Choosing a definition is important to communicate what your goals are regarding a CE. When this definition is clear, tenderers know what they must incorporate in their tender proposals. Once a municipality wants to pursue circularity in a land tender, this must become one of the main goals in a tender. This corresponds with a weight of 30% in the tender criteria. These tender criteria must as specifically as possible measure what the municipality wants to achieve in the tender. To implement this, criteria are designed which can be used to request circular materials or adaptive buildings.

Contents

1 Introduction

The awareness about climate change is rising globally. In the 2015 Paris agreement, almost all the countries in the world committed themselves to limit the global average temperature increase to 1.5°C (UNFCCC, 2015). Under this agreement, countries committed themselves to enforce policies and action plans to cut greenhouse gas emissions by 2050. The European Union (EU), which is one of the signers, has translated these goals in their long-term vision 'A clean planet for all'. In this vision, the strategy is laid out to accelerate the energy transition, roll out carbon free transport and boost the circular economy as a combination of these different aspect is necessary to reach the needed cut in greenhouse gas emissions (European Commission, 2018a).

Many countries have now committed themselves to a carbon neutral target around 2050, with a vision and action plan to reach these goals (UNFCC, n.d.). These visions and plans focus mainly on the energy transition (Ellen MacArthur Foundation, 2019). However, since the extraction and processing of the materials we currently use are responsible for 45% of the carbon emissions (European Commission, 2018a; Ellen MacArthur Foundation, 2019), a transition into a circular economy (CE) is necessary to reach the goal to be carbon neutral in 2050. Due to the fact that the current focus is more on plans for the energy transition, the transition into a CE is behind compared to the energy transition (Ellen MacArthur Foundation, 2019).

1.1 Problem area

The European Union and Dutch government both aim to be completely circular in 2050 (European Commission, 2015; Rijksoverheid, 2016). To reach this aim, they provide action plans which can be incorporated by lower governments, for example the EU guidelines on how circularity can be incorporated in procurement, but these are not as widely implemented as was agreed by the introduction (Núñez Ferrer, 2020). Since public procurement accounts for a large share of the GDP, 20% in the Netherlands, governments can have a lot of influence by how they procure (Neubauer et al., 2017). The research into the field of pursuing environmental goals through procurement is limited (Testa, Grappio, Gusmerotti, Iraldo, & Frey, 2015). In addition, only a few studies could be found on land tendering. Therefore, researching the effect of circular land tendering criteria can help to formulate these criteria in new tenders.

Pursuing environmental goals in land tendering is necessary because the activities in the construction industry account for 50% of the use of virgin materials in The Netherlands and 2/3 of all waste production in the EU is coming from the construction industry (Rijksoverheid, 2018b; European Commission, 2016). This illustrates that the construction industry is a key sector in CE policy and demonstrates the need for a study on how this policy is translated into land tendering.

1.2 Research objectives

An exploration of how CE building policy can be translated into a tender is done to explore the current state of CE building in the Netherlands. By connecting policy aims with the tender request and the tender proposal, an analysis is done on how CE aims move through the process from tender to building contract. This analysis is done with the aim of giving a set of recommendations how municipalities should implement CE building policy, based on the experiences from the first municipalities in the Netherlands that have implemented CE building policy in a tender. The tool of public procurement is specifically discussed because this is one of the most important tools of government to pursue CE for the government, and good CE public procurement is dependent on good CE policy (Sönnichsen & Clement, 2019).

1.2.1 Research question

This study gives an overview of how municipal CE building goals are implemented into land tendering. The aim is to improve circular land tendering requests by giving an insight in municipal land tendering goals and the translation of these goals in tender proposals. The research will be conducted by first creating a theoretical framework regarding CE and tendering. This is followed by case study analyses on the application of CE goals and measures in practice. By studying cases from different municipalities, varying CE goals, tender requests, and tender proposals can be compared. from this comparison conclusions can be drawn to answer the main research question:

''How can tender requests be improved to pursue municipal circular building goals in land tendering?''

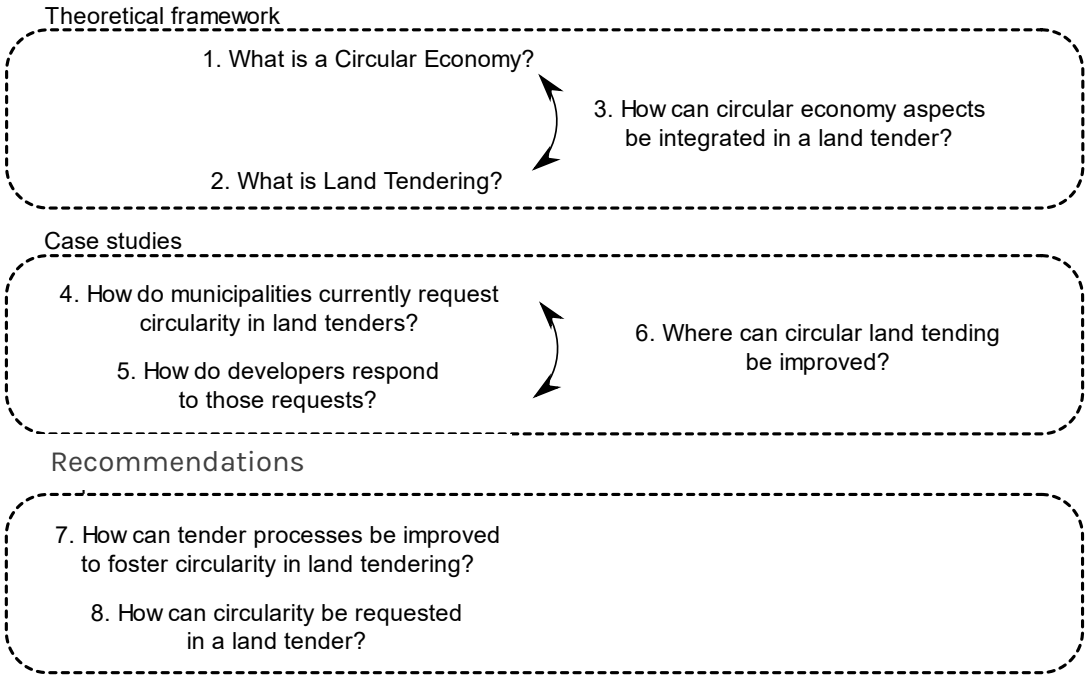


Figure 5: Conceptual model

This question is answered in three phases. The conceptual model in *figure 2* shows the three phases in which the research is conducted. Within these phases, two or three sub-questions are answered which are also sown in *figure 2*. First, the theoretical framework will lay a foundation on the circular economy and land tendering. This will then be further specified towards how the CE can be incorporated in a land tender.

In the second phase of the research, four cases of land tendering are investigated where circularity was incorporated in the tender. These four cases are each studied on three levels:

- Circular building policy
- Circularity in the tender request
- Circularity in the tender proposals

The aim is to find CE goals in the different levels, to see where the tender goals derive from. Subsequently, the correspondence of circularity in the tender proposal to the tender request is studied. Secondly, it is important to understand the motive of the real estate developer to incorporate circularity in the tender proposal to understand the effect of the tender request on a developer. By comparing the extent of circularity in these three levels potential room for improvement can be found. The aim is to find if there are any

mismatches in circular goals, from policy to tender proposal, and find where these mismatches can be found.

The third, and last, phase of the study focuses on proposals for the improvement of circular land tendering. In the second phase the room for improvement in circular land tendering is studied, here the solutions for this improvement are studied. A process proposal for a successful land tender is designed together with criteria how certain circular aims can be requested in a tender.

2 Methodology

As there is still little known about circular building and CE policy, this thesis places itself at the start of research into this topic and has an exploratory character. Such exploratory research generally has a qualitative character where multiple issues are investigated in a more descriptive and narrative nature (Kumar, 2010). In this study, the fields of CE and land tendering are combined, together with case study analyses to research the implementation of CE in land tendering.

The research design in *figure 3* shows the three different phases of this research. Phase one consists of the literature study, which aims to lay a theoretical foundation for the rest of the study. The second phase consists of a desk research into tender documents and other documents relevant to the case, supplemented with interviews with people involved with the cases from the municipal and real estate developer side. The last phase aims to compare the findings of the cases and come up with recommendations, which will be checked in a set of expert meetings.

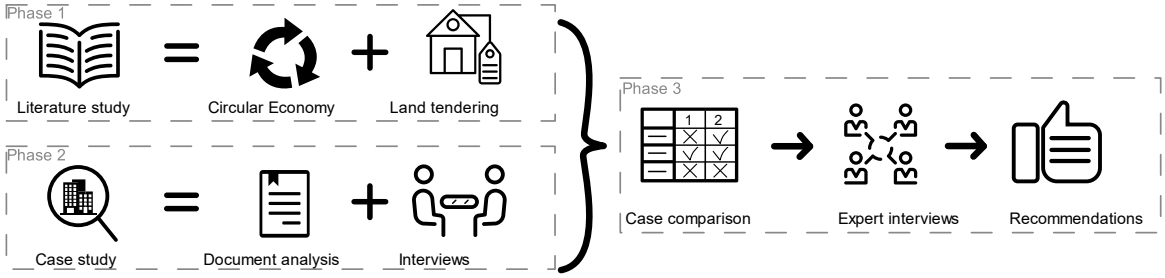


Figure 6: Research design

2.1 Literature study

The goal of the literature review is to identify what is already known on the issue, the existing concepts and theories, controversies and inconsistencies amongst existing literature and research methods and unanswered research questions (Bryman, 2012). The literature study is held as a narrative review, where the area of research is explored based on what the current body of knowledge is. An exploration of the CE topic is done with a bibliometric analysis, where the most influential papers are selected. The software tool 'CiteSpace' was used to visualize the body of knowledge on circular economy and identify the most recurring keywords (Harinarayana, n.d.). Further exploration of the topic is mainly done by 'snowballing', where literature is found by searching the referenced articles or searching for articles that have cited a found article.

2.1.1 Finding literature

Literature research was done on the topics of circular economy and land tendering. These topics are explored in a narrative review using online search engines Google.scholar and Scopus (scopus.com). Regarding the CE, this research will focus on the construction sector and land tendering. Since the field of CE is still in its infancy, the field of land tendering was occasionally also researched in a broader context, for example regarding sustainability or green development. The amount of research on land tendering was found to be very limited. Therefore, this literature review is broadened towards public procurement and the results are interpreted to a context where a plot of land is tendered.

The literature study into the theme of circular economy was done by using the keyword 'Circular Economy'. This keyword was then combined with other keywords: 'cities', 'urban', 'municipality', 'municipal', 'construction', 'construction sector', 'building', built environment' and 'circular development'. Additionally, some literature was used which was provided by the graduation mentors.

The topic of circular economy was further explored on the specific topic of policy. For this, the keywords ‘circular policy’ and ‘circular economy policy’ were used. These terms were also combined with the keywords ‘assessment’, ‘development’, ‘aims’ and ‘tools’ to find more specific information. Additionally, ‘circular policy’ and ‘circular economy policy’ was replaced with ‘sustainability’ or ‘sustainable’ to find literature regarding the implementation of sustainable policy, where the theory of sustainable policy introduction can be applied for CE policy introduction.

The last theme to be explored in the literature review is land tendering. As the amount of knowledge on land tendering specifically was found to be very limited, this was broadened towards public procurement. The keywords to find relevant literature on this topic were ‘circular’ or ‘circular economy’ Which was combined with ‘public procurement’, ‘tender’ and/or ‘criteria’. In the case of circular public procurement, the amount of research is very limited. Therefore, also a study was done with the terms ‘green public procurement’ and ‘sustainable public procurement’, which often have criteria overlapping with circular procurement criteria (Alhola, Ryding, Salmenperä, & Busch, 2018).

The literature study provides in establishing a solid theoretical base for the second part of the research: the case study. After this phase, the literature review is not yet finished but should still be elaborated based on findings out of the rest of the research (Bryman, 2012).

2.2 Case study

The second phase of the research consists of a case study. A case is often defined as a smaller, sometimes closed, system within the broader reality (Yazan, 2005). Although a case is often studied because the broader reality is too complex, the context should be investigated as well (Yin, 2013). In this thesis, a case is defined as a building project which was influenced by circular building policy and tendered by a municipality. Conducting a case study can then be subdivided in five phases: defining, designing the study, gathering, finalizing & validating data (Yazan, 2005).

2.2.1 Defining cases

The main criterion for a case in this study is that it is influenced by circular building policy and tendered by a municipality. This selection includes only land tenders where the municipality is not the end user as the relations between the municipality and the tenderer are different if the municipality is also the end-user. To research the outcome of circular building criteria, the tender should already be awarded at the moment the research is conducted. To keep the cases comparable with each other, the choice is made to use only cases from within the Netherlands, where the same juridical system is used.

Within the network of the graduation supervisors and professionals in the field of circular building an inventory was made on municipal tenders where circular building criteria were used. About half of these projects still need to be awarded, which gave a selection of five building projects in three different cities. To compare different municipal circular building policy, a project in each of these cities was selected. The final choice on the four cases in *table 3* is made by an information oriented selection, where cases with the most available information are selected (Flyvbjerg, 2006).

Table 3: Overview of the cases studied

	Amsterdam: Kop Zuidas	Amsterdam: Centrumeiland	Rotterdam: Delftseplein	Utrecht: HUQ
Max floor area	24.000 m^2	7.500 m^2	41.000 m^2	70.000 M^2
Functions	- Offices - Amenities - Housing - Parking	- Housing - Amenities (social, offices) - Parking	- Housing - Offices - Hotel possibility - Sharing facilities	- Housing - Commercial - Cultural functions
Circular criteria	Part of sustainability Make specific, BREEAM certificate	GPR score & qualitative justification	BREEAM certificate specified	Part of sustainability, contribution to CE
Weight criteria	15% sustainability	40 – 50% circularity	30% sustainability	~ 10% sustainability

2.2.2 Designing the Case study

The three cases which are selected are in three of the four biggest cities in the Netherlands. There were no awarded circular land tenders found outside of these cities, which can be explained by the fact that circular public procurement occurs more often in larger municipalities (Sönnichsen & Clement, 2019). The fact that all these cases are within the largest cities within the Netherlands brings up the question whether the results of this study are applicable in other cities. Based on a case study, only conceptual or analytical conclusions should be drawn, these are generally more suitable for generalization than specific conclusions (Yin, 2013). The sub-research questions focus on the conceptual level, for example what is done to implement policy in tender requests, and how real estate developers respond to tender requests. The concepts will be similar in other municipalities but can occur in more or less extent, depending on other side conditions.

2.2.3 Gathering, finalizing & validating data

Figure 3 shows the case study consists of a desk research into the relevant documents and conducting interviews with relevant stakeholders. The documents were found on the websites of the three municipalities. Information on the tendering was found on Tenderned and received from the tendering municipalities and the real estate developers participating into the tender. Additional information was retrieved by using the project's name in search engines on the internet.

The validation of case studies demands special attention because the number of researched objects is quite limited. Information about cases should always be derived from multiple data sources, such as interviews, observations and document reviewing (Yazan, 2005; Yin, 2013). For this research, the content of documents is studied, and additional interviews are conducted with people involved with these documents, to get a deeper understanding on the meaning and validate conclusions which were drawn from the document.

A case study should always consist of a minimum of two interviews, one on the procuring side of the case and one on that of the tenderer or real estate developer. This is necessary to understand the goals and intentions of both parties, apart from what is written in the documents. The interviews will be conducted with employees involved with the CE part of the tender. Most of these employees are sustainability managers involved with the project. The interview protocol of these interviews is added in Appendix 2: Interview protocols.

The validation of the case study conclusions occurs in step 3 in *figure 3*. Based on a comparative analysis, conclusions are drawn up. These are discussed with several experts

on the subject, mostly consultants in the field of circular tendering. The found conclusions are presented to the experts for a reflection to validate and refine them.

2.3 Research output

The aim of this research is to improve circular land tendering by giving an insight in municipal land tendering goals regarding the circular economy, with a link towards how real estate developers respond to these tenders. Therefore, the output of the research should be recommendations that can be implemented by municipalities for a successful circular land tender.

These recommendations are done at two levels: first a process design is made which illustrates a process to successfully implement circularity in a land tender. Secondly two tender criteria are designed, which can be incorporated in a land tender for the goals of circular materials and adaptivity.

2.3.1 Ethical considerations

The research is exploring a new field of research using four cases. This makes the information traceable to involved companies and people. Because of the low number of projects involved with CE and a low number of cases, all the information in this thesis is easy traceable to the relevant case.

Theoretical Framework Part 1:

Circular Economy

3 Circular Economy

3.1 Defining circular economy

The CE is a field of study which has been studied intensively the past decades. Since there are many definitions, it helps to understand who play central roles in the discussion on CE. In a bibliographic study the number of citations per source is visualised, together with the centrality in the overall network. The software tool of CiteSpace was used to do this because it can order networks based on a variety of variables, for example by node terms, and visualize these in a network (Harinarayana, n.d.).

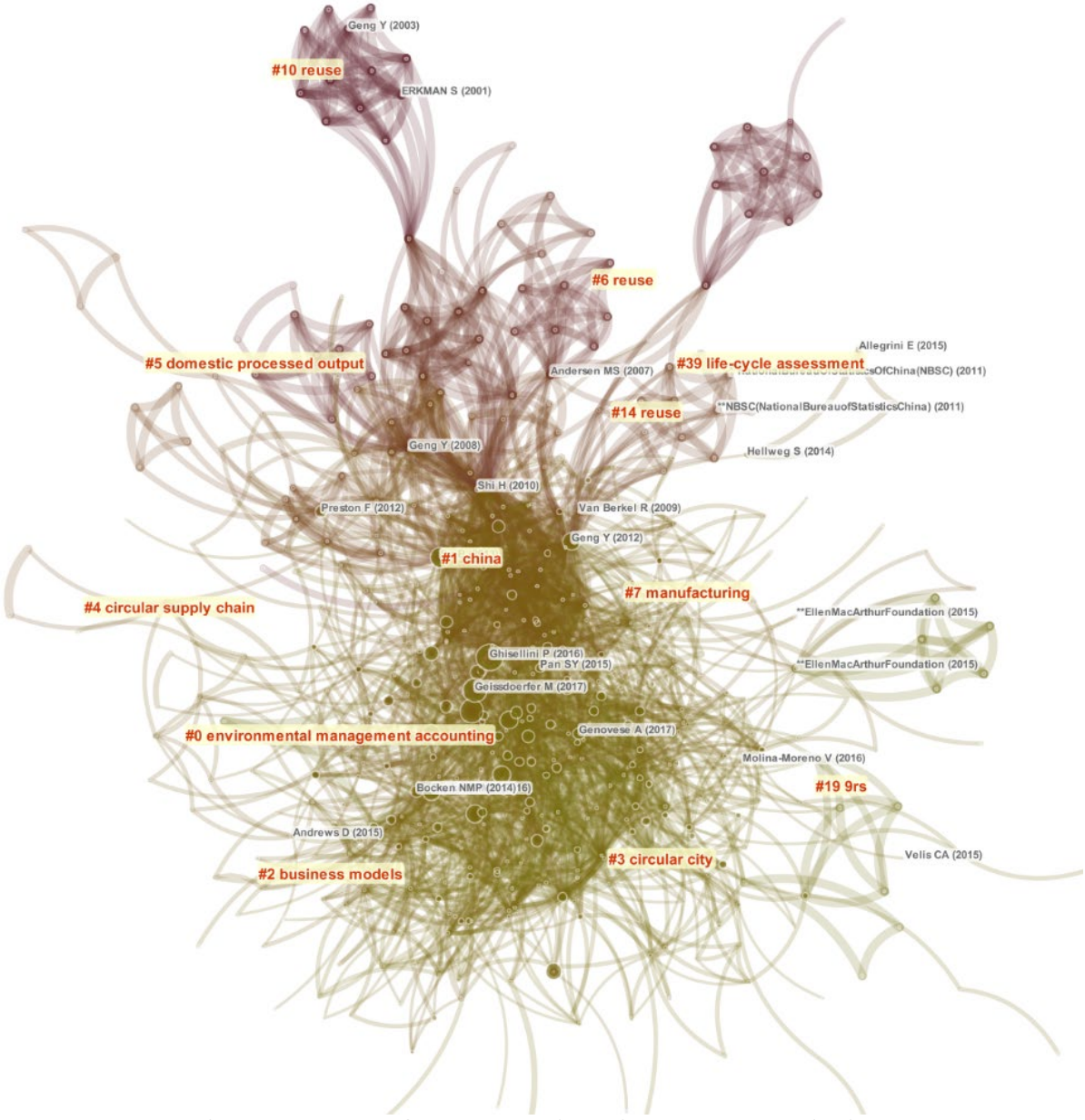


Figure 7: Network of papers covering "Circular Economy" in title

The network of 704 unique research papers covering “Circular Economy” which were found on the web of knowledge is displayed in figure 4. The figure shows all papers with ‘Circular Economy’ in the title as a dot, the more often a paper is cited the bigger the dot. The lines in between the dots indicate that a paper has cited a different paper as its reference. Figure 4 shows a dense network of research papers, indicating that the papers cite other papers

regarding CE intensively. The papers are clustered by their keywords, showing the following most often occurring keywords (listed from most occurring to least occurring):

1. Environmental management accounting
2. China
3. Business models
4. Circular city
5. Circular supply chain
6. Domestic processed output
7. Reuse
8. Manufacturing

This list of keywords tells us something about which aspects of a CE are most studied. The most used keyword is 'environmental management accounting', indicating that a CE is often related to environmental management accounting. The second most occurring keyword is China, a country which seems strongly involved with implementing a CE to overcome the problems generated by its rapid growth (Ghisellini, Cialani, & Ulgiati, 2016). The keywords 'business models', 'circular supply chain' and 'manufacturing' indicate that a CE has a business component which is often researched next to the environmental management component. Additionally, the circular city is a popular research subject related to CE. This indicates that the role of cities regarding the development towards a CE is found to be interesting. In the following subsections the most cited papers, each of them is cited more than 400 times, will be discussed shortly to give an overview of what aspects of CE are mostly referred to in scientific papers. All the five papers describe a literature review to find a clearer definition on what a CE is. The fact that these five papers have been mostly cited by other papers writing on CE indicates that many of the researchers are looking for a definition of CE.

A literature review by Ghisellini et al. (2016) is the most cited reference in the bibliographic research. This literature review shows that the CE model is presented as a model to replace the current economic model, the linear economy. This is done from different backgrounds and approaches. The concept of a CE has two main approaches, the most studied approach in literature is the environmental approach. A system where no useful material or energy is lost but it re-enters the value chain as new material. The second approach is the economic approach. The economic system which deals with re-using the materials and energy, by implementing new business models, product-use schemes etc.

The second most cited reference in the bibliographic study is a literature review studying the concepts of CE and sustainability to find similarities and differences (Geissdoerfer, Savaget, Bocken, & Hultink, 2017). The similarities are not clearly defined in research, but it was found that CE and sustainability both address a global, inter- & intragenerational commitment. They both integrate multidisciplinary aspects to innovate at the core where business plays a central role. Sustainability is seen as a holistic concept, which is sometimes also regarded as vague, where CE is by most research papers narrowed down to a concept of material input, waste, and emission output. Broader studies do sometimes also incorporate social aspects such as job creation and behavioural change necessary for a CE. However, this is still more narrow than the concept of sustainability; it is therefore found that CE can be perceived as a condition or beneficial relation to sustainability.

Kirchherr et al. (2017) researched the terms which are used in scientific literature to define a CE. In this research, 114 different definitions of CE were found. Around 2/3 of these incorporate the terms 'Reuse' and 'Recycle' as core principles and almost half of the definitions use the term 'Reduce'. These three terms are by far the most popular principles in CE definitions.

The study by Lieder and Rashid (2016) focuses on the implementation of CE with three main aspects: environment, resources, and economic benefits. Literature has a focus on the environmental aspects of a CE. This will not be sufficient for the implementation of a CE. A CE is defined as an economy which is the collective nexus between a government pursuing environmental goals, interests of public institutions, and bottom-up initiatives. A CE can only be reached if the goals of both these parties are incorporated into the final economy.

The paper by Tukker (2015) is an exploration of the status of research towards product service systems. This is seen as a business model in a CE. The paper compares result-oriented service systems and product or use-oriented service systems. In a product or use-oriented service systems. a supplier is responsible to deliver a product or service. In a result-oriented service system a supplier is responsible to deliver a result. This last one is found to have a bigger incentive for the supplier to minimise materials and optimise the result. Therefore, this is more suitable in a CE. Overall, it is concluded that consumers are not ready for new CE business cases such as the product service systems because consumers still favour control over their things, artefacts, and life itself by becoming the owner of products.

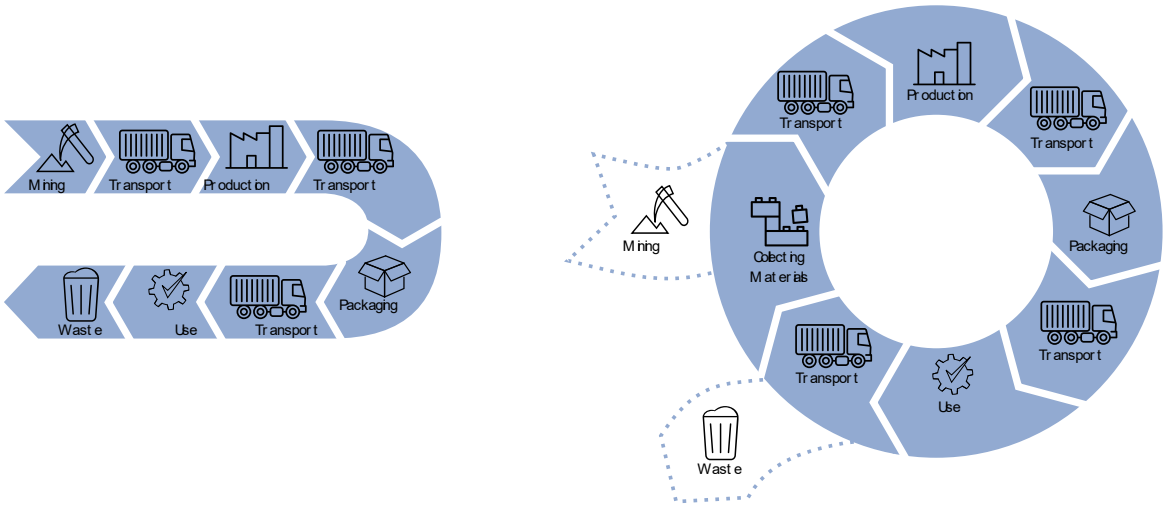


Figure 8 Linear and circular material stream

From these five studies it can be concluded that there is still a search going on for the definition of a CE. Scientists do agree that a CE has two aspects: environmental and economic. In most cases the focus of a CE is put to material streams, to minimise waste and virgin materials in comparison with our current linear economy. “CE is a strategy that emerges to oppose the traditional open-ended system, aiming to face the challenge of resource scarcity and waste disposal in a win-win approach with economic and value perspective.” (Homrich, Galvão, Abadia, & Carvalho, 2018, p. 534). This comparison is visualised in figure 5, showing all the steps where a CE should be implemented in the value chain (Nasir, Genovese, Acquaye, Koh, & Yamaoh, 2017). In a completely CE, the actions of mining and waste from figure 5 will completely disappear, in the transition process from a linear economy towards a CE these actions will gradually diminish.

3.2 Circular economy models

The growing interest in a CE has not only produced scientific knowledge but also reports on how the theory can be implemented in business models, cities etc. This paragraph will

discuss some of the most popular theories that have been used in Dutch policy documents and will also be used in the case studies.

The previous section showed that the terms 'reuse' and 'recycle' were found popular in definitions of a CE. These two terms return in the R-ladder, also referred to as ladder of Lansink. This describes several steps which should be followed in a circular material cycle. There are several different R-ladders known, ranging from 3-R-steps to 10-R-steps (Kirchherr et al., 2017). The ladders are shown in table 4 and the column on the right tells us the substance of each R-step in the 10R-ladder. The steps must be followed chronologically from top to bottom, where the goal is to be as high as possible on the ladder to lengthen the use of materials (PBL, 2017). The substance of the steps varies per ladder, where the step 'reduce' in the 3R and 4R-ladder can also incorporate the first two steps in the 10R-ladder. The use of the ladders is also a matter of 'redefining' what the substance of the step means for the project where the ladder is used, and which number of steps fits its user's purpose the best.

3R- ladder	4R- ladder	10R- ladder	Substance of R-step (10R framework)
		1. Refuse	Preventing use of raw materials
		2. Rethink	Rethinking the need for necessary materials
1. Reduce	1. Reduce	3. Reduce	Reducing use of raw materials
2. Re-use	2. Re-use	4. Re-use	Product reuse (second-hand & product sharing)
		5. Repair	Maintenance & repair
		6. Refurbish	Refurbishing a product
		7. Remanufacture	Creating new products from old products
		8. Repurpose	Product reuse for different purpose
3. Recycle	4. Recycle	9. Recycle	Processing and reuse of materials
	5. Recover	10. Recover	Energy recovery from materials

Table 4: R-ladders (based on PBL, 2017; RLI, 2015; Kirchherr et al., 2017)

Where the R-ladder describes circularity on a material scale, many theories describe the economy on a higher scale level. The Ellen MacArthur Foundation is a leading organisation in the field of circularity. They have a lot of influence on businesses and policy makers with their reports. The foundation has defined a CE based on three principles (Ellen MacArthur Foundation, 2019):

- Design out waste & Pollution
- Keep products and materials in use
- Regenerate natural systems.

These three principles are visualised in figure 6 on the scale of the CE system. The first principle is shown at the top, the principle of keeping materials in use is separated in two categories of cycles, the biological cycles. The technical cycles and the two arrows at the bottom visualize that negative externalities on systems regarding food, shelter, health, etc. should be minimised (Ellen MacArthur Foundation (2015b).

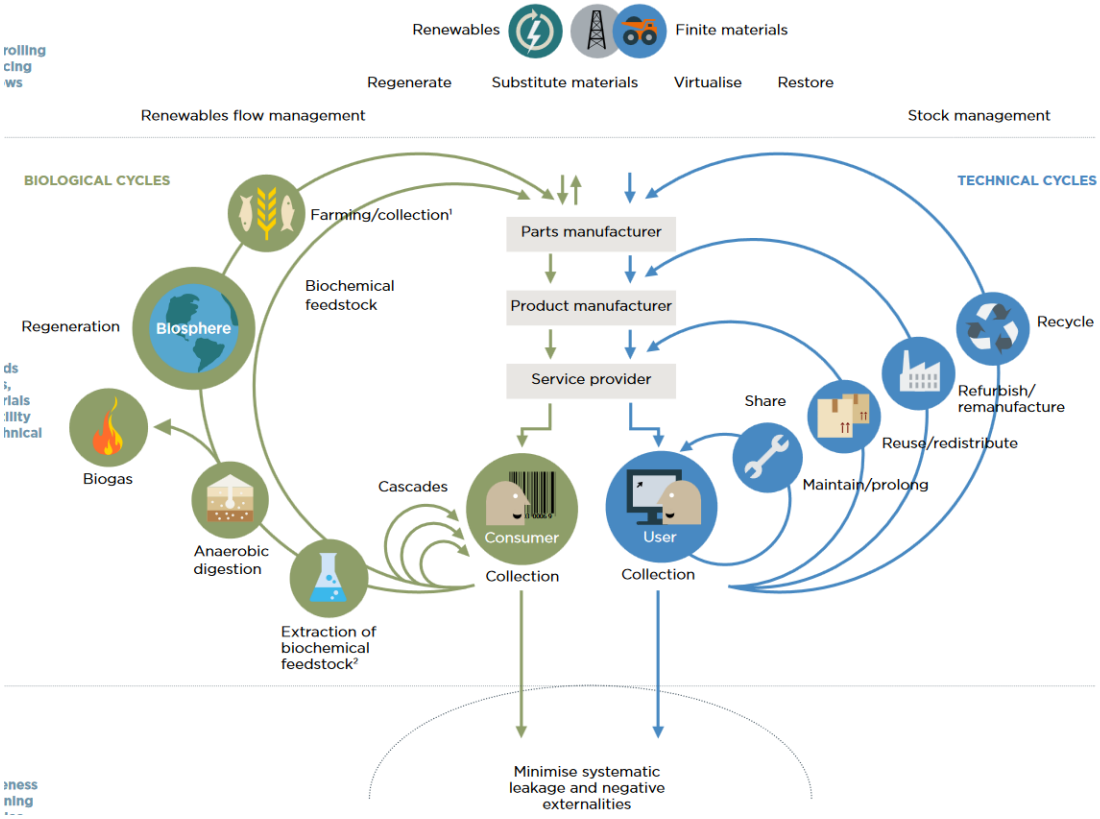


Figure 9: Circular Economy Systems diagram (Ellen MacArthur Foundation, 2015)

The purpose of the systems diagram in figure 6 is to keep looping cycles as much as possible in the inner circles. To implement this, the diagram is accompanied by a framework for implementation: the RESOLVE framework. This framework is an action plan to make business models circular in 6 steps (Ellen MacArthur Foundation, 2015b):

1. REgenerate: shift to renewable energy and materials
2. Share: share products to maximise use
3. Optimise: increase performance and remove waste in production & supply chain
4. Loop: keep materials in closed loops (recycling)
5. Virtualise: deliver utilities virtually to minimise materials
6. Exchange: replace old materials with advanced new technologies

This framework is found to be the most comprehensive framework that is currently available and is therefore widely used by businesses to incorporate a CE in their business model (Lewandowski, 2016).

Eva Gladek is the founder of consultancy company Metabolic. She has published a model with 'the seven pillars of a CE' (Gladek, 2019). The model was developed to establish a set of counterparts to balance material cycles. This model illustrates that a CE involves more than the technical and biological cycles, with also more social pillars involved such as health and wellbeing, society and culture and social value. The model, visualized in figure 7, shows the final state of a circular economy, where the economy is a contribution on all these seven pillars (Gladek, 2019).

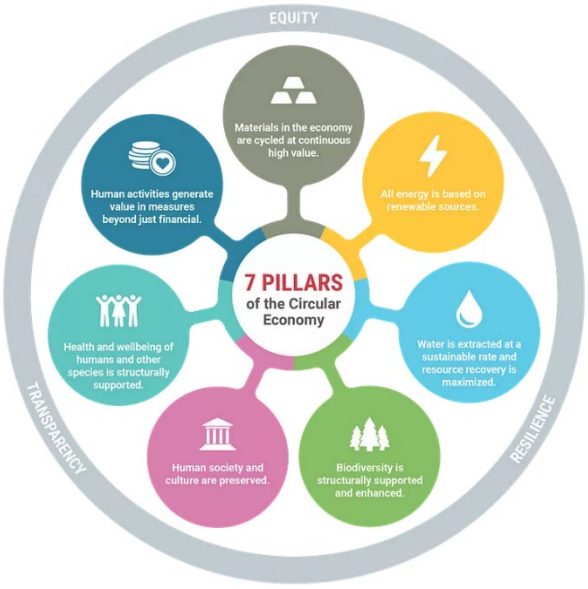


Figure 10 The seven pillars of a circular economy (Gladek, 2019).

Similar to the seven pillars from Gladek, the Doughnut economy model by Kate Raworth (2012) in figure 8 illustrates a wider range of goals in a CE. This model distinguishes an environmental ceiling and a social foundation, which are the boundaries of safe and just space for humanity. The social foundation forms a boundary of social aspects such as a sufficiency of food, health, education, and income. These form the social foundation of social aspects to prevent human deprivation. The outer boundary forms the environmental ceiling, beyond this ceiling there is an environmental degradation (Raworth, 2012). For each aspect in the inner and outer part of the doughnut, a score is calculated; these scores must be within the boundaries to lead to a safe and just space for humanity. A difference between the doughnut model and the seven pillars by Gladek is that the doughnut model can be used as a transformative tool towards the CE. The city of Amsterdam has calculated their current state in the model and now uses the doughnut to support initiatives which will steer the city in between the boundaries (Doughnut Economics Action Lab, Circle Economy, C40 Cities, & Biomicry 3.8, 2020).

Figure 11: Doughnut Economy (Raworth, 2012).

The model of a CE by Williams (2019a) is a response to the RESOLVE framework of the Ellen MacArthur Foundation. Williams argues that the RESOLVE framework is not applicable to the CE transformation on the scale of a city. Cities operate in a complex field with a wide diversity of stakeholders, operating in different sectors and various scales. The RESOLVE framework is made for an industrial or commercial actor for ecological optimisation within a single sector. The urban context Land and infrastructure are important aspects for a circular city, but these are not directly integrated within the RESOLVE framework. The approach by Williams puts the urban activities such as travel, leisure, construction in a central position. Therefore, she defined three key-actions, followed by four actions supporting the three key actions for resources needed and generated by the urban activities (Williams, 2019a):

1. Looping: recycling, building refurbishment
2. Adapting: flexible buildings, modular design
3. Regeneration: production of energy, food, and soil
4. Localise: Use local agriculture, energy & currency
5. Substitution: service-based provision of heat or clean water, durable infrastructure
6. Sharing: Co working, cohousing, vehicle sharing
7. Optimising: Smart grid, energy/water efficient buildings

Next to the fact that there are multiple definitions of a CE, there are also multiple models to describe the implementation of a CE. These start at the narrowest definition, where material looping is achieved with different steps on the R-ladder, to more broader definitions which include also social aspects.

3.3 Circular construction

CE implementation in the building sector is different than CE implementation in other sectors. Solutions regarding extending the life span of short-lived products and highly standardized products are not commonly applicable to the construction sector because the construction sector deals with unique one-off products with a long lifespan (Pomponi & Moncaster, 2017). Simultaneously, there is a high urgency to develop a CE in the construction sector because 50% of the use of all virgin materials in the Netherlands is used for construction and ⅓ of all waste production in the EU is coming from the construction industry (Rijksoverheid, 2018b; European Commission, 2016). This urgency is also felt because the EU and the Netherlands both have specific action plans targeting the construction sector for a transition towards a CE. However, this transition is still in its infancy stage (Adams, Osmani, Thorpe, & Thornback, 2017).

In the construction sector, a CE is often perceived as just another sustainability or recycling initiative (Adams et al., 2017), to realise the sustainability goals (Saidani et al., 2019). Due to the focus in the construction sector on cost minimisation, circularity is often limited to minimising waste generation during demolition (Adams et al., 2017). When more attention is given to circularity, it is often limited to the materials which are used in a building. This has two main circular aspects: the recyclability and the carbon footprint of the materials (Nuñez-Cacho, Górecki, Molina-Moreno, & Corpas-Iglesias, 2018). The recyclability of materials refers to how materials can be reused after they become obsolete in a building. The recycling activities which are financially attractive have already been adopted by the market, but further recycling activities have stalled (Nasir et al., 2017). To further enhance recycling, the R-ladder, discussed in paragraph 3.2, can be used to define the options. However, not everyone perceives recycling of materials in the built environment as the most viable option. Since materials are most often used for a longer time than other sectors (Pomponi & Moncaster, 2017). The model of shearing layers by Brand (1994), displayed in figure 9, is often used as a framework for the lifetime of materials. This model shows the different layers which together form a building. The stuff

within a building, consisting of furniture, lamps, phones, etc., is the most flexible layer which changes from daily to monthly. The structural elements of a building will often last for 100 years, or even longer, forming the most enduring layer of a building apart from the site, which will be there eternally. In the short-term cycles, such as stuff, looping activities can be like other sectors. However, in the long-term cycles it becomes uncertain when and how materials can be reused, due to the long timespan.

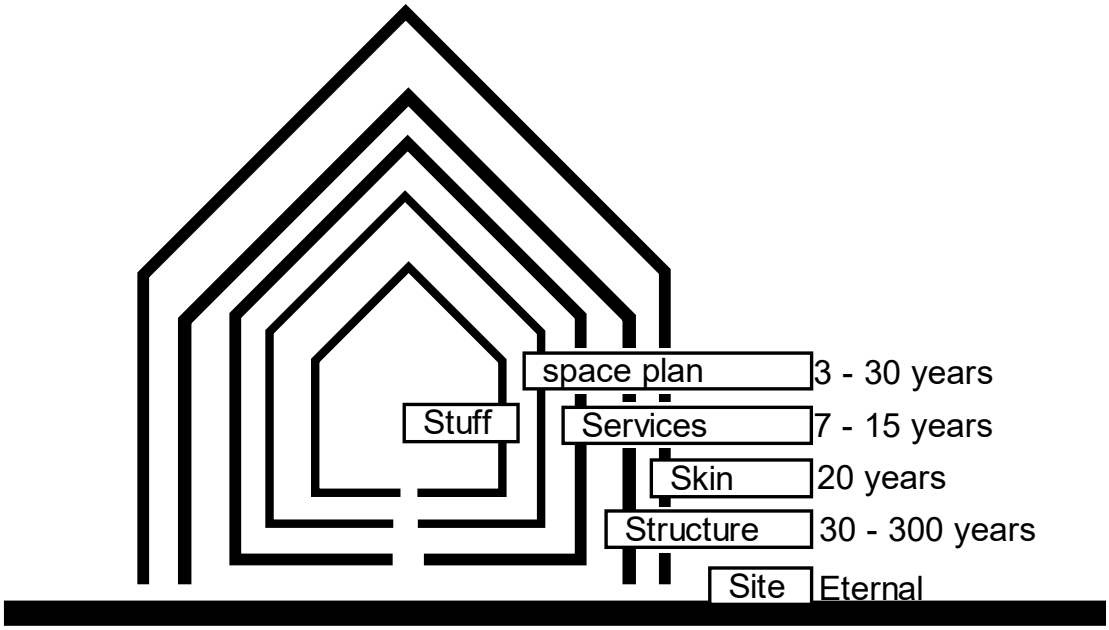


Figure 12: Shearing layers by Brand (1994)

Next to the recyclability of materials, the carbon footprint of materials is defined as main circular aspect (Nuñez-Cacho et al., 2018). A Life Cycle Assessment (LCA) and Material Flow Analysis (MFA) are established methods to calculate the environmental impact of a building through a longer timespan (Pomponi & Moncaster, 2017). An LCA maps the environmental impact of a material from the production of a material up to discarding the product, taking all steps in figure 5 into account (Nasir et al., 2017; Tarantini, Loprieno, & Porta, 2011). One of the benefits of an LCA is that it clearly shows where in the process the biggest environmental impact is made and which steps are best to improve (Tarantini, et al., 2011). Where an LCA maps the carbon footprint for one product, an MFA follows a material during the period it is used, from when a material is extracted during all the life cycles as a product until it is discarded in the end (Chen, 2009). A difficulty with the LCA and MFA methods is that during the construction phase, when the CE value of a building is most often calculated, only information up to that point is available and estimations on the recyclability have to be included (Iacovidou & Purnell, 2016).

In the Netherlands, an LCA calculation is incorporated in a score for the 'environmental performance of buildings' (MPG), where an environmental price is calculated per material, based on the life cycle from production to demolition with a potential discount for reuse (ten Bosch, Levels-Vermeer, & de Graaff, 2019). The average score for housing is currently €0,58 per m^2 and € 0,81 per m^2 for offices, thus the effect of the determined maximum of €1 per m^2 is too high to have a significant effect on the environmental footprint of materials (W/E adviseurs, 2019). To promote circularity, the maximum MPG must be lowered to a more ambitious level (Backes, Boeve, Koolhoven, & Versteeg, 2018). Although, a different measurement method may be better because the MPG score, and other methods which are used to calculate sustainability scores, are not found to be suitable in the transition towards a CE (Di Maio, Rem, Baldé, & Polder, 2017; Platform CB'23, 2019; Saidani et al., 2019).

Often the perception regarding the material looping, water and energy management are found to be the most important aspects, next to the application of the R-ladder principles (Nuñez-Cacho et al., 2018). A research by Consultancy firm ARUP shows that there are already broader actions taken in the built environment (ARUP, 2016). In each step of the RESOLVE framework by the Ellen MacArthur foundation, CE initiatives were found. This indicates that the CE can be applied very broadly in the built environment. But these initiatives are still scarce because the CE in the construction industry is still in its infancy stages (Adams et al., 2017). Professionals in the construction industry perceive their own knowledge on the CE as too limited (Tura et al., 2019). The most important enablers for CE in the construction sector seen by the professionals are the creation of a clear business case, closely followed by other enablers such as a viable take back scheme for circular materials, the development of new markets and technologies and awareness creation (Adams et al., 2017). In addition to the demand for a business case, the high initial investment is regarded as a barrier because of the economic risk, especially for smaller companies which may be unprofitable due to a small sales market (Tura et al., 2019). These initial investment costs can be up to 25% higher for a circular building compared to a non-circular building but a part of these costs can be earned back if the materials are sold after use (Copper8 & Alba Concepts, 2017).

3.4 Policy on Circular Economy

Circular policy emerged from the end of the first decennium of this era. This has started by public funding for research into circularity, policies for CE have followed about a decennium afterwards (Stahel, 2016; van Bueren, 2009). However, CE principles were already implemented in sustainable policies in the 1990's. Mainly to address issues with raw materials or to found eco-industrial parks which stimulate closed loops regarding water and energy (Winans, Kendall, & Deng, 2017). Nowadays, China, Japan and Europe are globally the leading regions where CE policy has gained a prominent role (Heck, 2006; McDowall et al., 2017). The common features of CE policies in these regions is to acknowledge the central role CE will play in the future economy, including exploring the potential benefits of CE regarding employment and economic gains (Kalmykova, Sadagopan, & Rosado, 2018). However, the aim of China's policy is different than the European aim. China has founded innovation programmes where experiments take place at different scales. Additionally, China is focussed more on the depletion of virgin materials than the European policy, which is more derived from the goals regarding sustainability. Europe is also experimenting with circular indicators on a wider scale, whereas many Chinese indicators are still associated with general sustainability indicators (McDowall et al., 2017). On a national level in Europe and North America, the focus of CE policies generally towards waste minimisation and recycling. While a bigger societal and legislative change is needed to reach the goals of the Paris agreement (Winans et al., 2017; Material Economics, 2019).

CE policy can be targeted at three different scales: the micro, meso and macro level. The micro level is concerned with materials and single buildings. The meso level involves a cluster of buildings, sometimes seen as eco-parks. The macro level is concerned with the scale from a city until the international scale (Saidani, Yannou, Leroy, Cluzel, & Kendall, 2019). In most cases, policy on the highest scale, on macro level, will affect the lower scales, leading to more specific policies on the micro and meso level (Winans, Kendall, & Deng, 2017).

On a global scale, the 'Paris agreement' was signed by many countries, where they commit themselves to an average global temperature increase of 1.5°C (UNFCCC, 2015). This agreement formulates the end goal but does not formulate specific strategies to reach this. The signing countries are obliged to formulate a vision and action plan to individually

become carbon neutral in 2050 (UNFCC, n.d.). On a smaller scale, the European Union has implemented policy to promote a CE. This policy (Closing the Loop) starts with defining the end goal of a CE: "where the value of products, materials and resources is maintained in the economy for as long as possible, and the generation of waste minimised" (European Commission, 2015, pp. 2). This policy is still on a very abstract level but does already define some key sectors where the focus for the transition should be. The construction sector is a focus sector and the 'EU Construction & Demolition Waste Management Protocol' is the EU's action plan towards a circular building sector. The focus of this plan is on minimising the waste generation of the building sector by increasing the confidence in the quality of waste material as recycled construction material. The implementation of this plan is mainly the responsibility of national governments, which should implement the guidelines that are given in the plan for the transition to a circular building sector (European Commission, 2016).

From the actions at an international level, we see that the responsibility for implementation lies mainly at national governments. In the Netherlands, the policy 'Nederland circulair in 2050' (the Netherlands circular in 2050) is the main umbrella policy regarding the CE transition. Unlike the EU policy, a definition for a CE is not given. However, the policy states that it is about an economy which suffices in the needs without unacceptable environmental pressure and without the depletion of natural resources. To reach this, the vision is to have an economy which uses as little resources as possible (Rijksoverheid, 2016).

Like the EU policy, the Dutch policy also chooses focus industries of which the construction sector is one. A three phased transition path is formulated for the construction sector. Having a basecamp in 2021, being 50% circular in 2030 and being 100% circular in 2050. The Dutch 'Transitieagenda circulaire bouweconomie' (transition agenda circular building economy) focuses on the first phase of creating a basecamp. The focus of the agenda is less on the waste generation than the European plan. In the Netherlands, already 97% of construction waste is reused, mainly as a lower quality material, for example as granulate under new roads (Rijksoverheid, 2018b). Because the agenda focuses on the basecamp, most of the plans are focused on the process towards a CE. Together with private parties, semi-public institutes and other governmental boards, more circular showcase projects must be realised, a material passport will be worked out and more research into a circular building sector will be done (Rijksoverheid, 2018b).

Apart from these policies at European and national level, the implementation of CE building policies occurs mostly on local level (IRP, 2017; Wolfram, van der Heijden, Juhola, & Patterson, 2018). Cities increasingly see themselves as a hotspot for CE and because they are involved with many resource and waste streams, they are suitable to develop CE policy (Climate-KIC & C40 Cities, 2018; Petit-Boix & Leipold, 2018; Ellen MacArthur Foundation, 2015a; World Economic Forum 2018). The form and focus of CE policy vary per city. Amsterdam is generally seen as one of the frontrunners on CE policy, as they have a vision on two sectors: a circular construction chain and circular organic waste streams. These visions are further elaborated in a roadmap for circular land tendering and funding and space for bio-based projects (Gemeente Amsterdam, 2015a). Internationally, London is also perceived as one of the frontrunners due to the London waste and recycling board (LWARB), a dedicated partnership from the mayor of London and stakeholders from the waste sector to change waste management in London. This partnership has, like the EU and the Netherlands, identified five focus areas of which the construction sector is one, with interventions and economic benefits in each of these areas (LWARB, 2017).

Not all cities are acting as progressive as Amsterdam and London. Research on general sustainability policy shows that sustainability is rarely a driver to pursue the policy, it is

more often seen as a threat to the local economy. Sustainability policies are mainly pursued to comply with national legislation (Gibbs, Jonas, & While, 2002). Cities which do implement CE policy expect different benefits on environmental, economic, health and societal level (Govindan & Hasanagic, 2018). Which are translated into different goals:

- A lower carbon footprint of materials with a circular business case compared to linear materials (Nasir et al., 2017).
- The creation of new jobs due to other production processes (Arup, 2016).
- The improvement of employment conditions in the sourcing and construction of buildings and poor health climates during the operation phase with better monitoring systems (Arup, 2016).
- Increase entry-level local employment possibilities and the extended life of products (Govindan & Hasanagic, 2018).

This wide number of benefits regarding a CE can make policy formulation more difficult because there is a lack of a clear definition among the interest groups (Chatterton & Style, 2001). Additionally, evaluation of the available policies is scarce, making it difficult to determine which policies work and which do not (Petit-Boix & Leipold, 2018; van der Heijden, 2019).

Although evaluation of policies is limited, many scholars have done suggestions towards possible tools of government to induce the CE. The government should:

- Provide the regulatory standards (Williams, 2016; Williams, 2019b; Linder, Sarasini, & van Loon, 2017; Material Economics, 2019; Taskforce Herijking Afvalstoffen, 2019).
- Introduce stimulating measures such as material trading places (Material Economics, 2019; Ellen MacArthur Foundation, 2019; Williams, 2019b).
- Rethink taxation (Ellen MacArthur Foundation, 2013) for example by a landfill tax rate (Iacovidou & Purnell, 2016).
- Introduce regulations for re-use (Material Economics, 2019; Taskforce Herijking Afvalstoffen, 2019).
- Subsidisation (Material Economic, 2019; van der Heijden, 2013).
- Provide stable policy to make investments profitable (Tura et al., 2019).
- Remove legislative barriers (Ellen MacArthur Foundation, 2015a; IRP, 2017; Taskforce Herijking Afvalstoffen, 2019).

3.5 Circular city aims

When a CE is translated to the scale and influence of a city, other principles apply. Williams (2019a) found the RESOLVE framework by the Ellen MacArthur Foundation unsuitable for the application on a city, therefore a new framework is made. In this framework, the city is described as "a complex, heterotrophic artificial ecosystem in which resources are produced and consumed by a variety of activities, initiated by inter-dependent actors, across multiple sectors and scales. Materials, water, energy, land, and infrastructure are produced and consumed by actors within the urban ecosystem by a range of activities. These activities relate to the consumption, creation, and operation of the city (systems of provision and consumption). Activities include travel, shopping, leisure, education, manufacturing, construction and farming." (Williams, 2019a, pp. 2755). The Framework by Williams has three main aims: looping, adapting and regeneration. These are the core aspects of a circular city, where there is no waste. Products and materials are recycled and used for as long as possible because they are adaptive to changing demands. The energy demand for recycling and production is generated within the city to prevent negative externalities. The remaining four aims of localise, substitution, sharing and optimising are seen by Williams as supporting aims, used to further enhance the CE in a city (Williams, 2019a).

These seven aims will be elaborated on in the next seven sub-paragraphs. The meaning and purpose of the aims by Williams is given for each aim, together with other literature regarding the circular aim.

3.5.1 Looping

The concepts 'Reuse' and 'Recycle' are the most reoccurring concepts in CE definitions and are inextricably connected to CE (Kirchherr et al., 2017). The aim of looping is to limit resource use within cities by reusing and recycling the resources within the city. Williams (2019a) distinguishes four important categories of resources which should be addressed in this aim: water, energy, land, and construction materials.

Strategies regarding water and energy are mainly focussing on reusing greywater and recycling food waste for energy production. Since these themes have a close interconnection with the aims of regeneration and optimising, they will be explained further in the next paragraphs addressing those aims.

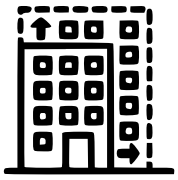
Williams (2019a) elaborates extensively on the land looping actions for a city, as she states land is found to be one of the most important resources of a city. Here she argues that due to the cost of decontamination, difficulties with land assembly, and speculation, vacant land can be found in cities, disusing the potential which lies on the land plot. This problem is found mainly in hedge cities, where foreign and corporate acquisition of land accelerated after the economic crisis. A problem that lies here is that low-value activities such as regenerative urban forestry, recycling industries and pop-up activities often lose ground in the competition for space with high-value activities (Williams, 2019a). City governments should respond to these trends by using zoning restriction to promote activities such as urban forestry and recycling because these activities are essential for the implementation of circular actions in cities (Williams, 2019a). On the other hand, there is a problem with the linear land use in places where land prices are not booming. These places face the problems of soil contamination, a depletion of minerals, and the scarcity of the land available as a resource for urban functions such as urban farming and climate adaptation (Breure, Lijzen, & Maring, 2018). Therefore, looping actions are necessary to ensure land availability for further generations.

The concept of reusing or recycling building materials from existing buildings is often referred to as urban mining. In a study on the urban mining possibilities in Amsterdam, it was found that currently most of the metals in buildings are recycled somewhere in the demolition process (Koutamanis, van Reijn, & van Bueren, 2018). This study found that this is mainly because of the high value of metals, which is recognized by demolition workers. This shows that when there is a financial incentive, skilled workers are able to recognise recycling potential and the industry will adopt it. For less valuable materials it was noted that the deconstruction of a building usually takes more time than demolition, and due to time restrictions for new constructions the industry often chooses for demolition rather than taking the building apart (Iacovidou & Purnell, 2016). Another issue with reusing materials is found in the uncertainty of up until when the materials can be reused: the long lifespan of buildings makes it hard to predict when materials will have value and if it is financially feasible to store materials in the meantime (Iacovidou & Purnell, 2016).

Apart from her paper on the different CE policy aims for cities, Williams has written a specific paper on the challenges for looping actions. In this paper, Williams (2019b) finds 58 challenges for cities regarding the implementation of looping actions, which can be categorised in eight themes that have to be overcome for looping actions:

- Socio-cultural: Cultural values such as materialism and individualism have led to little interest in looping activities and a devaluation of recycled products.
- Economic & financial: A lack of interest in waste or looped resources leads to a low economic value of these products. With a low price of virgin materials, it is difficult to make a suitable business case.
- Information: Although the emergence of smart cities and big data causes more and more data to become available, the amount of data on resource and energy use is still limited. Data to manage and monitor looping activities is needed.
- Regulatory: Regulations can hamper looping actions by setting the bar too high for resource quality. Additionally, the absence of regulations can make consumers sceptical of the use of recycled materials. The challenge is a set of criteria that indicate the quality of looped goods.
- Political: Through neo-liberalistic policy, governments have fewer financial means and power over society. This makes governments reliable on private parties.
- Institutional: Currently institutions are industry based. For looping activities, institutions must look past their industry and see possibilities by connecting with other industries
- Technical & Design: Systems must be redesigned to become circular, which is a big disruption and requires new socio-technical systems.
- Environmental: The space available for recycling activities is often limited, for example land contamination reduces the potential for grey-water reuse and land recycling.

These challenges must be overcome, and policy should be aware of these challenges. The current CE policy is often focussed mainly on individual looping actions (such as the reuse of grey water) while many of these challenges are on a broader scale in activating looping actions throughout the city (Williams, 2019b).



3.5.2 Adapting

The aim to make the city more adaptable to changes consists of concepts like flexible buildings and modular designs. Cities currently often lack the capacity to adapt to changes, especially in their infrastructure (Williams, 2019a). This is because buildings and infrastructure are almost always erected for a long time span, coping with a high initial investment which has to be earned back over time (Chester, Markolf, & Allenby, 2019). While society is changing, existing buildings and infrastructure do not move along. A more flexible and adaptive infrastructure is needed which can respond changes in capacity demands and technological innovations (Chester et al., 2019).

Designing for adaptation can be one of the most successful CE aims because it tackles material use high in R-framework. Successful adaptation leads to a direct reduction of resource use because a changed demand can be responded to without the need for reprocessing, leading to a direct and indirect reduction of waste generation, energy use and carbon emission savings (Iacovidou & Purnell, 2016).

Currently adaptive building is not yet incorporated in all construction works. The building's characteristics such as used materials, used installations and to what extent they meet the building regulations account for 44% of the factors of why buildings are not yet built adaptive. The other 56% is related to management issues such as the financial situation and a lack of awareness on the need for adaptive building (Israelsson & Hansson, 2009).

3.5.3 Regeneration

Regenerate is the first action in the RESOLVE-framework by the Ellen MacArthur Foundation. In this framework regeneration is described with three action areas (Ellen MacArthur Foundation, 2015a):

- Shift to renewable energy and materials
- Reclaim, retain, and restore health of ecosystems
- Return recovered biological resources to the biosphere

Williams (2019a) only refers to the restoration of the urban ecosystems in her framework. The ecosystems must be restored, and natural capital preserved. This is done by the incorporation of green and blue areas in the public space and on buildings. Economist Kate Raworth also takes the perspective of the ecosystem capabilities to define a healthy economic growth. She has developed a 'doughnut model' where the hole in the middle illustrates 'critical human deprivations' and the area around the doughnut represents the 'critical natural threshold'; a healthy economic development should stay within these boundaries (Raworth, 2012, p. 21).

3.5.4 Localise

The current separation of the city citizen and system from the hinterland where production takes place leads to a decreased interest in actions to minimize resource use and waste production (Rosales, 2017; Williams, 2019b). By localising resources of the consumed products and the waste treatment in the city, all the, both negative and positive, externalities become visible and apply to the city directly. Williams (2019a) pleads for localising resources such as food production and energy harvesting to create conscience about the negative externalities. Currently, cities have an area outside the city where most resources are produced. A study on the largest cities around the Baltic Sea estimated that the cities needed an area approximately 200 times the size of the physical footprint of the city for the production of food and materials, in order to neutralise emissions from nitrogen, phosphorous and carbon dioxide. (Folke, Jansson, Larsson, & Constanza, 1997).

Retrieving all the materials from the hinterland leads to negative externalities at the production location, but cities also face negative effects from the import of materials. In the case of infrastructure construction, building materials are retrieved more often from a global scale. This makes them more expensive and reduces their ease of access (Chester, et al., 2019). In case of the production of energy, a shift will come because of the generation of energy. Currently, most of the electricity is generated by powerplants outside of the city. However, renewable energy will be generated closer to the city because this is best placed in resource optimal sites or close to the consumer (Kammen & Sunter, 2016).

Rosales (2017) pleads for self-sufficient cities, which are necessary to become fully sustainable. The city is seen as one ecosystem: everything that is consumed within the city is also produced in the city. This will address the problem that people currently do not see the negative externalities and will thus likely increase the demand for sustainable and recycled resources.

3.5.5 Substitution

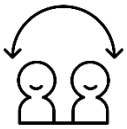
The aim of substitution is a combination from the aims 'virtualise' and 'exchange' in the RESOLVE framework. Williams (2019a) combines these because both represent the substitution of a linear economy product into a new circular economy product. In the case of virtualise, the aim is to substitute materialised products for virtual products with for example the substitution of books for e-books or the shift from an office building into virtual office places (Ellen MacArthur Foundation, 2015a).

Exchanging is also about the substitution of linear economy products but in this case not with virtual alternatives. Instead, they are substituted with new, advanced technology products. Examples of this are new 3D-printing techniques or substituting fossil fuel engines with electrical engines (Ellen MacArthur Foundation, 2015a). Williams (2019a) combines these as the substitution of non-renewable resources with renewable resources.

Next to the substitution of non-renewable materials for renewable materials, there is also a substitution of the linear business model for a circular business model. Williams (2019a) exemplifies the service-based provision of a heated home instead of purchasing a boiler. Here, the traditional business model of selling boilers is substituted for a business model where income is generated by delivering heat as well as by including maintenance in the business model. Businesses must reconsider their way of value creation and how they gain their profit. These new CE business model aspects have been brought together in a morphological box, leading to a theoretical maximum of 4 million new business models that are involved with material repurposing, recycling, reusing, etc. (Lüdeke-Freund, Gold, & Bocken, 2018). In a study targeted specific to the real estate sector, the Ellen MacArthur Foundation and Arup narrowed these down to six new business models for real estate in a CE (ARUP & Ellen MacArthur Foundation, 2020):

- Flexible spaces: Allow landlords or tenants to lease out any unused space within the building
- Adaptable assets: Design a building which allows for multiple uses to make it adaptable for changing market demands.
- Relocatable buildings: Deploy a portfolio of relocatable buildings to be erected on vacant land.
- Residual value: Future contracts specify the ownership of the materials once a building is demolished, giving incentive to design for deconstruction to keep futures contract prices high.
- Performance procurement: Introduce leasing systems for (parts of) buildings; providing real estate as a service

Almost all these business models are also found under one of the other aims for CE, either in looping the materials or making buildings more adaptable. Governments should still be closely involved in developing these new business models because it might also require a shift in legislation to make the business models possible (ARUP & Ellen MacArthur Foundation, 2020).



3.5.6 Sharing

Williams (2019a) speaks about sharing resources in cities, such as co-housing, co-working, and public transport, as well as vehicle sharing systems. Resource sharing can be an important contribution to CE development because the same living standard can be achieved with less resources (Ellen MacArthur Foundation, 2015a). As a policy aim, cities should stimulate business models which introduce resource sharing. For example, by designating parking space for car-sharing or allowing co-housing initiatives (Ellen MacArthur Foundation, 2015a).

3.5.7 Optimising

Globally, cities consume up to 80% of the energy supply (UNEP, 2012). There is already a wide diversity in how cities try to decrease domestic energy consumption, which mostly focuses on replacing appliances with more energy efficient alternatives. However, more advanced policy is needed which focuses on the technical and societal aspects of energy saving (Goggins, Fahy, & Jensen, 2019). Governmental support is also needed on the coordination of energy streams. Because of new generation

techniques and the increase in energy demand, the networks are becoming less stable and cities should introduce smart grids that react to these changes (Kammen & Sunter, 2016). These smart grids should incorporate different energy demands, such as electricity, heat, and gas, and should be able to store energy in the timespan between production peaks and consumption peaks (Kammen & Sunter, 2016).

Apart from energy, water is an increasing important theme in circular cities. The water consumption in cities has increased considerably over time. Globally, many cities now suffer from water depletion. This is mainly because 90% of the water available in these cities is used for agricultural irrigation (Richter et al., 2013). Historically, water planners have given much greater attention to supply management to access more water, than demand management to limit water use, even though it has been found that strategies to limit water use are by far the cheapest to fight the water shortage in cities (Richter et al., 2013).

Next to energy and water, a stream of other materials for products goes into a city every day. This thesis focusses on construction materials for the built environment. Iacovidou & Purnell see three ways to optimise the construction material stream. First, natural materials such as straw and hemp can be used instead of steel and concrete. Secondly, through recycling materials such as concrete and post-consumer plastic in new structural elements. Thirdly, the excess use of materials must be tackled because around one third of all material used in the manufacturing of construction components is excess material. This can be done by simplifying site work or stop using of over-specified components (Iacovidou & Purnell, 2016).

3.6 Pursuing circular economy policy

Governments have various tools to pursue the aims they set on a CE. The Ellen MacArthur Foundation (2015a) published 'A toolkit for policymakers', in which a proposal is done how CE policy can be constructed and implemented. A further elaboration on the tools is done by Prendeville, Cherim & Bocken (2018), who distinguish six governmental tools for policy implementation:

- Knowledge development
- Collaboration platforms
- Business support schemes
- Fiscal Frameworks
- Regulatory frameworks
- Procurement & Infrastructure

The first two of these governmental tools are closely related and are pioneering activities. New knowledge is created and shared (Prendeville et al., 2018; Bardach 2000). Because the CE is still in its infancy, knowledge creation and distribution is relevant to get consensus on the implications of a CE for cities and create showcase projects to give increasing attention to the CE (Petit-Boix & Leipold, 2018; Prendeville et al., 2018; Ntsonde & Aggeri, 2019).

The latter four tools for policy implementation can generally be implemented after the pioneering phase. Business support schemes and fiscal framework are governmental tools which are used to stimulate the private sector to pursue a goal (Prendeville et al., 2018). For example, by subsidizing initiatives which contribute to the goal. Fiscal frameworks refer to taxing. To stimulate a CE, virgin materials must be taxed instead of labour taxing, this would overcome the problem that a CE is labour intensive and low in material use (Stahel, 2013; CEPS, 2016).

Drawing up regulatory frameworks is perceived as a stricter tool than financial support (Vabo & Røiseland, 2012). In the tool of regulatory frameworks governments use their authority to set regulatory standards (Bardach, 2000). For the enforcement of a CE the tool of regulatory frameworks is barely used yet (Vabo & Røiseland, 2012), municipalities are often hindered in implementing circular policy because it conflicts with national or European policy (Backes et al., 2018). However, many studies have suggested that governments should provide the regulatory standards for CE (Williams, 2016; Williams, 2019b; Linder et al., 2017; Material Economics, 2019; Taskforce Herijking Afvalstoffen, 2019). Establishing objective metrics is seen as a tool which can help clients and producers systematically to increase the circularity level (Linder et al., 2017; Williams, 2016; Williams, 2019b).

The last tool of government in the list by Prendeville et al., (2018) is procurement & infrastructure. Governments increasingly use their purchasing & tendering power to pursue their goals (Prendeville et al., 2018; Blay 2014). Public procurement accounts for 20% of the GDP in the Netherlands, and even around a quarter of the GDP in the construction sector (Neubauer et al., 2017; Wamelink et al., 2018). With procurement, governments can challenge the market to be more ambitious than the regulations. Therefore, public procurement is seen as a tool to pursue smart, sustainable, and inclusive growth, which creates opportunities for circular procurement (Backes et al., 2018).

3.7 Conclusions

The first part of the theoretical framework addresses the theme of circular economy. By doing that, this part answers the first sub-question:

1. What is a circular economy?

3.7.1 What is a circular economy?

In paragraph 3.1, it was discussed that there are over a hundred definitions found of a circular economy, making it difficult to give a uniform definition of a CE. The most cited literature is literature that explores different contents of a CE. Important conclusions are that a CE has an environmental and an economic aspect, and both these aspects have different perspectives on a CE. The environmental perspective sees the reduction of environmental harm due to a decrease of material use. The economic perspective views more the application of a CE, studying new business models and employment opportunities which are part of a CE.

When a CE is defined, the terms ‘reuse’ and ‘recycle’ are used the most often. This refers to looping activities, which perform a prominent role in CE implementation models. However, like how there are over a hundred definitions of a CE, there are also many models which describe differently how a CE should be implemented. Narrow models are limited to the looping of materials, where more broad models also include social aspects. For the aim of this research, a model which describes circular cities is more elaborately discussed. In this model, it is assumed that the city is a place which should facilitate all the activities in it to become circular. The three aims of looping, adapting and regeneration are found to be the three core elements of a circular city. Looping means that the city provides that all materials can be reused and thus there is no waste generated in the city. Adaptivity refers to the capacity of a city to adapt to changes, for example functions of a building that can change when the demand changes. Regeneration refers to the shift to renewable energy and materials and retaining biological ecosystems and cycles. Together with the four supporting aims (localise, substitution, sharing, optimising).

The pursuit of CE goals by governments can be done in different ways. It is found that cities play an important role due to their scale level. They are concerned with waste streams and can control material streams. This is already done by different governmental tools. The tool

of procurement, or land tendering, is found suitable due to the large impact on the private sector and the possibility to set circular requirements in tenders.

In conclusion, there is not one answer to the question what a circular economy is. An important aspect of the circular economy is the looping of materials to minimise the use of virgin materials. This is often perceived from two perspectives: the environmental and economic perspective. The environmental perspective wants to reduce the use of virgin materials to minimise environmental harm. The economic perspective sees new business models and employment opportunities due to new recycling activities.

Theoretical Framework Part 2:

Circular tendering

4 Circular tendering

4.1 Public procurement

Public procurement is the act where a government purchases a good or service from the market. Purchasing decisions used to be based on the lowest price, starting from the 1980s, quality aspects were also incorporated in selecting the best offer (Waara & Bröchner, 2006). With a share of 20% of the GDP in the Netherlands, around 6% higher than the European average, public procurement defines a large share of the market (Neubauer et al., 2017). For the construction sector, the share of public procurement is even higher as it is estimated that around a quarter of the volume of all the procurement in this sector is done by public authorities (Wamelink et al., 2018). This allows public institutions to have a large influence on the market. Therefore, public contracts have been converted into an important tool to implement policies (Prendeville et al., 2018; Blay, 2014).

In the Netherlands, Public parties are subject to European procurement policy when the procured goods or service exceeds the threshold of €5.535.000 (European Commission, 2019b). Additional to this threshold, EU procurement policy is only applicable for land tendering when agreements are made which transcend the law (Hobma, 2010). This means that EU procurement policy is applicable if governments want to sell their land, with a value above the threshold, and make additional agreements for example on circular construction. In these cases, the government must then follow the procedures of the European directive (European Commission, 2014). Here, a tenderer can be selected as economically most advantageous, where quality aspects can be added to price selection (Bergman & Lundberg, 2013).

4.2 Land tendering

Land tendering is slightly different than public procurement. In land tendering, a public body does not buy something but sells the right to develop a building on the land to the market, using tender allocation to select a party for the development (Caesar, 2015). The goal of this agreement is for the developer to get the exclusive building rights to build on the plot, according to the plans from the tender proposal (Røsnes, 2015). The goal of a land tender is, from a procuring perspective, to select a party which fulfils the municipal goals in the best fitting way. Although it is important to understand this difference, there are also many similarities between public procurement and land tendering. In both cases, the municipality will select a party which is the best in fulfilling the demands from the municipal request. Since research in the field of public procurement is far more advanced than the research in the field of land tendering, a literature study is done to the selection methods in public procurement in order to understand the motives of selection.

4.3 Green, sustainable & circular procurement

Where qualitative tendering is used to pursue environmental goals, it is often referred to as green public procurement (GPP). This "is about setting environmental criteria while complying with the legal principles of the free movement of goods, transparency and equal treatment of bidders" (Palmujoki, Parikka-Alhola, & Ekroos, 2010, pp. 261). When social sustainability criteria are also added next to the environmental criteria, it is often referred to as sustainable public procurement (SPP) (Uttam, Balfors, & Faith-Ell, 2014). Both these procurement methods are seen as good market-based instruments to provide incentives for the procuring party and the procurers to become voluntary more sustainable (Bratt, Hallstedt, Robèrt, Broman, & Oldmark, 2013). For the implementation in tender procurement processes, guidelines are available. In 2011, the United Nations released their programme 'buying for a better world', a guide for public and private parties on how their procurement policy can contribute to a sustainable world (UNEP, 2011). This has led to other programmes on smaller scales. The European Commission developed standard criteria sets which can be used by procuring parties in their tenders under the EU directive

(European Commission, 2019c). However, in 2020 the EU concluded that these SPP guidelines were not as widely adapted in the member state as was agreed upon introduction in 2014 (Núñez Ferrer, 2020).

The slow adaptation of SPP can be explained by the fact that there are still barriers for the implementation of SPP. Poor management often leads to financial issues. This makes sustainable procurement more expensive, while it is often in fact cheaper than non-sustainable procurement (Testa et al., 2015). Additionally, poor goal formulation, which is not derived from the policy, and poor control systems lead to unsuccessful tenders (Bratt et al., 2013; Palmujoki et al., 2010). Where SPP is successfully implemented, policy aims are adopted in tender proposals and realised in the building. In these successful tenders, the influence of social procurement criteria is found more impactful than environmental criteria, due to the fact that the industry has already integrated sustainability more in their standard processes (Amann, K. Roehrich, Eßig, & Harland, 2014). In the case of circular procurement, the market has not yet widely adopted circularity. This means that an opportunity can be found to introduce circular criteria in tendering.

The field of circular public procurement (CPP) is generally less developed than GPP or SPP (Sönnichsen & Clement, 2019). Experience with CPP is mainly found where it touches GPP or SPP. The EU guidelines on SPP for example also include criteria regarding recycling and a longer lifetime (Neubauer et al., 2017). Consequently, many purchasing departments already practice CPP without knowing it (Alhola et al., 2018). To move CPP beyond criteria touching on GPP or SPP, a game changer in the procuring organisation is needed. This person is preferably backed up with CE policy, to underline the importance of circularity (Sönnichsen & Clement, 2019).

There is still quite a debate on the definition of CPP, due to the fact that there is also still debate on the definition of CE. Like the definition of CE, which often included reusing and recycling of materials, the definitions of CPP often include these concepts as well. Based on multiple descriptions, circular procurement is defined as (Alhola, Salmenperä, Ryding, & Busch, 2017, pp. 12):

> *''The procurement of competitively priced products, services or systems that lead to extended lifespan, value retention and/or remarkably improved and non-risky cycling of biological or technical materials, compared to other solutions for a similar purpose on the market.''*

This definition can be interpreted as adding CE goals, such as looping materials and extending the time of use, to a procurement process. When this definition is adapted for land tendering it can be interpreted that CE goals must be added to the tender. An example of such goals is the previously introduced seven goals of a circular city by Williams.

4.4 Circular Tendering

The tender process is addressed in four phases, preparation, selection, awarding and assessment. Each phase will be subsequently addressed in this chapter. Each paragraph describes for one step in the tender process what needs to be done to promote circular solutions in the tender proposals as much as possible.

4.4.1 Preparation

All steps that are taken before the tendering belong to the preparation phase of the tender. In this phase the demands for the tender request are narrowed down, before the tenderers will further elaborate the plans (Witjes & Lozano, 2016). The preparation starts with the availability of policy. This helps organisations to understand why they are conducting CPP and what the goals of a CPP process are (van Oppen et al., 2018). Consequently, parties

which have CE policy are often more successful in implementing their CE criteria than companies without CE policy (Sönnichsen & Clement, 2019). This policy must be translated onto the tender, so project specific goals are made. Ideally, these project specific goals relate to the circular policy, and the project specific goals contribute to realising the overall circular vision (Waara & Bröchner, 2006; van Oppen et al., 2018). When the goals have been formulated these can be tested with the market in a dialogue prior to tendering. The goal of this dialogue is to understand what the market can offer regarding CE, to improve the formulated tender request and get better tender entries (Sönnichsen & Clement, 2019; van Haagen, 2018).

When the CE goals (and goals on other topics) have been defined, the tender process is further designed. For tendering under European regulations, five procurement methods are possible (Sweett, 2012):

Open procedure	Anyone can enter the tender, not advised for construction procurement because of potential high number of entries.
Restricted procedure	Two stage procedure, after a short evaluation about 5 parties are selected to make a final tender proposal.
Accelerated restricted procedure	Only available when there is a proven matter of urgency, reduces timescale compared to restricted procedure.
Negotiated procedure	Procuring party selects one or more parties with whom to negotiate a contract, is rarely used due to stricter regulations.
Competitive dialogue	For complex contracts where a dialogue with entry parties is desirable to discuss the entry.

Out of these procurement methods, a competitive dialogue is preferred for a circular construction project. This procedure is developed for tenders where a lot of uncertainty is involved (Winch, 2010). During a competitive procedure, the procuring party receives more information from the entering parties, which is often desired with circular building (PIANOo, 2019).

The last step in the preparation is the formulation of the tender request. This consists of a brief of requirements and tender criteria. The brief of requirements formulates what is requested from the market, for example a building or housing for elderly. This request should be formulated as an open, functional request instead of the current more often technical (specifications oriented) request (Backes, et al., 2018; van Oppen et al., 2018; van Haagen, 2018; Witjes & Lozano, 2016). In the example of an office, this would mean the number of workspaces is specified instead of the amount of floor space, giving freedom to the tenderers to come with creative concepts. Subsequently, tender criteria are defined. These are used to assess tender proposals in the selection and awarding phase. The functioning of these criteria is therefore explained in the following paragraphs.

4.4.2 Selection phase

A selection phase is only held in a two-stage tender. It generally has two purposes (Stichting Instituut voor Bouwrecht, 2019):

- Selecting suitable tenderers who are able to conduct the project
- Narrowing down the number of tenderers to limit the number of tenderers who invest a lot of time and money in a proposal

Tenderers are often required to show their capability based on reference projects. Within these projects, specific requirements can be set to assess the capability regarding a specific subject (PIANOo, 2019). This can be done for experience with CE projects but should not be done. The subject of circularity is relatively new, so the number of parties with circular experience is limited. When experience with CE projects is required, the selection of parties can become too limited for competition (van Haagen, 2018). Additionally, excluding these parties from the tender may also exclude some creative solutions (Tarantini et al., 2011). Apart from assessing circular experience, tenderers can also be

assessed based on a vision regarding circularity in the selection phase (van Haagen, 2018). By requiring a CE vision from the tenderers, the procuring party can assess which tenderer best suits their own vision on a CE and select the tenderer who is best capable of fulfilling the project specific goals identified in the preparation phase (van Oppen et al., 2018).

4.4.3 Awarding phase

The winner of the tender is selected in the awarding phase. Using pre-defined criteria, the best scoring tenderer is awarded. Including circularity in the assessment criteria of the awarding phase is the most efficient (Backes, et al., 2018). On average, municipal tenders have three quality related criteria in place (Waara & Bröchner, 2006). These criteria do not necessarily have to be very different from the selection phase, they are only based on more elaborate plans.

In his assessment framework, van Haagen (2018) makes a distinction between two kinds of awarding criteria: criteria on the technical substance of circularity and criteria on the process aspects of circularity. Technical CE criteria should measure the contribution to a goal, to create competition between tenderers on this goal (Backes et al., 2018). For example, challenging tenderers to use as little virgin materials as possible. The kind of criteria that can be adopted in the awarding phase are discussed in chapter 4.5 where all the circular aims are discussed together with possible criteria. Overall, it is important to formulate these criteria as specific as possible. More specific criteria will often lead to better solutions (Sönnichsen & Clement, 2019). Overall, CE criteria must be explicitly incorporated in a tender, to give tenderers an incentive to incorporate CE measures (Van Haagen, 2018).

The process criteria relate to the process aspects during the construction and use of a building or product. These process criteria can be shaped in different ways. For example, an action plan can be requested so tenderers realise that other processes apply to a circular project than to a non-circular project (van Haagen, 2018). Process criteria can also be shaped towards finding the best circular option in collaboration with the procuring party, the tenderer and within the production chain of the product (Witjes & Lozano, 2016; van Oppen et al., 2018).

4.4.4 Assessment

When all tender proposals are received, the last phase of the tender arrives. The tender proposals are assessed based on how they score on the defined criteria. Regarding the subject of circularity, two aspects are important in this phase: the assessment team and how price is included in the tender assessment. In addition, the assessment of the sustainability and circularity criteria is also important, but these have been discussed in the previous.

The first aspect in this phase is the composition of the assessment team. CE is a broad subject, many of the circular assessment criteria remain subjective. Therefore, the assessment must be done by a multidisciplinary team of at least five people (van Haagen, 2018). This ensures an assessment which is as objective as possible.

The second aspect in this phase is how the price is considered in the assessment. Van Haagen (2018) assesses two price aspects: the weight of the price criterion, and how the price is calculated. Regarding this last issue, the total cost of ownership (TCO) should be brought into the criterion instead of awarding based on the initial investment costs. By calculating the TCO, tenderers are motivated to make an initial investment, which can save costs later in the operation phase. A qualitative substantiation should be made in addition to the price calculation, including the extra costs of CE measures, to ensure proper price calculations (van Haagen, 2018). Next to the price calculation, the price weight is an

assessment criterion by van Haagen (2018), who states price should not weight more than 30% in the total assessment. This is done to ensure tenderers do not have an incentive to cut on costs to the disadvantage of CE measures. To ensure a real estate developer will pay attention to the CE specifications of the tender, the CE criteria should have sufficient weight compared to all other criteria qualitative criteria, such as the architectural quality or the programme. There are no guidelines yet on the weight of CE criteria in a tender. Regarding sustainability criteria it was found a weight of 5% is insignificant (Palmujoki et al., 2010). The EU guidelines state a minimum weight of 10% to 15% for sustainability criteria (European Commission, 2008). The average weight of sustainable criteria in Italian tenders was found to be 18% (Testa et al., 2015), and for the price criteria van Haagen (2018) says 30% will have a significant effect on the outcome. Therefore, literature suggests that criteria of 20% - 30% have significant influence on the design.

4.5 Circular Tender criteria

In the previous paragraph it is discussed how circular building can be incorporated in the procurement process. This chapter will give examples on possible tender criteria. Several studies emphasize that every procurement process is different, therefore nothing can be said on which criteria suit the specific procurement process (van Oppen et al., 2018; van Haagen, 2018). In general, criteria should not exclude specific circular solutions and should stimulate tenderers to be as circular as possible (Backes et al., 2018). The criteria which are discussed in this chapter are categorised based on the circular aims, which are introduced in paragraph 3.5.

CE criteria can be implemented in multiple ways in a tender, most often they derive from the existing EU or other eco-labels (Tarantini et al., 2011). BREEAM and LEED certificates are such kind of labels which are often used. However, these certificates often address CE aspects only in a limited way. For example, by assigning credits to a minimum recycled content, without considering the material specific production processes and environmental impacts (Tarantini et al., 2011). Therefore, CE assessment tools must be adapted to local circumstances before they are used in a tender (Testa et al., 2015).

All the found criteria are listed in appendix 10.3, these are examples of what can be included in a tender. Some criteria may be contradicting, for example high insulation standards versus material use. Therefore, deliberately select the criteria to ensure that these correspond to the defined project goals.

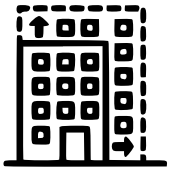
4.5.1 Looping

In paragraph 3.5.1 the aim of looping is discussed as preventing waste and re-using materials, water and soil again for new projects. The found criteria (listed in appendix 10.3) can be roughly categorised in the use of reused construction materials, waste management and reuse potential.

To stimulate the use of recycled materials, a certain amount of recycled materials can be requested. More process related criteria, such as an investigation towards the reuse potential of an existing building, are also possible (UKGBC, 2019). 85% of professionals from the construction sector in the UK believe that the reuse of materials should be part of a construction contract (Ghaffar, Burman, & Braimah, 2020).

Waste management is the second aspect of looping tender criteria. Here, the tender criteria can aim to maximise looping actions by separating waste streams. These can be used for both, the construction phase and when the building is in use. The criteria in both categories aim to optimise waste collection, so it is easier to recycle the waste.

Finally, looping aims can be achieved by focusing on the end of life of a building. With take-back schemes or modular buildings the reuse of materials can be stimulated. Overall, the chosen criterion will depend largely on the specific project. Requiring an investigation of reuse possibilities from existing buildings will only be applicable if there are any existing buildings. And reusing these materials might make it more complicated to design for deconstruct, so if any of these criteria are incorporated, the procuring party should have a vision which aspects are the most relevant for the tender.



4.5.2 Adapting

The adaptive capacity of a building is the capacity to accommodate a changing demand. There are two categories of criteria listed in appendix 10.3 with the aim of adapting. The first one is regarding an adaptive building management, the second one is regarding the adaptive capabilities of the physical building.

The building management should be capable of responding to changing needs in the building's functionality. When the use of a building changes, this will probably have an impact on the business case. By requiring a strategy on changing demands in the tender, tenderers are forced to think how their building can incorporate these changes. This strategy will then likely lead to changes in the building. These changes can also be requested directly in tender criteria, for example by requiring different scenarios for the floorplan layout or an elaboration on how the building interior can be disassembled for a new use (UKGBC, 2019).

4.5.3 Regeneration

The aim of regeneration refers to the regeneration of energy or regeneration the eco-systems, as is explained in paragraph 3.5.3. For both purposes criteria can be incorporated within the tender.

Energy production can be tendered by a criterion on the energy production on site, or close to the site. The production of energy is often combined with the energy consumption of a building, leading into a total net energy use. This can be requested in tender criteria but will also be incorporated in the building permit approval from 2021 (RVO, n.d.). Criteria towards the regeneration of eco-systems are limited. On a qualitative level, a vision regarding the eco-system can be requested and in specific cases the environmental building management may be incorporated.

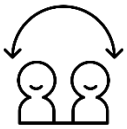
4.5.4 Localise

The aim to localise the material sources is mostly a secondary effect from the criteria in appendix 10.3. Criteria for local energy generation and the environmental impact of materials are found. These criteria will have an impact on locally produced energy and materials, but also have the goal to realise different circular aims.

4.5.5 Substitution

Current strongly polluting products should be substituted with new more environmentally friendly projects of business cases, as explained in paragraph 3.5.5. The procurement of new, substituting, materials and services, and business models, is seen as an important aspect of public procurement for a circular economy (Alhola et al., 2018). The criteria in appendix 10.3 substitute the current materials and business cases in different ways.

Most criteria for substitution focus on the exclusion of harmful materials. There are lists available of harmful materials, which can be used as exclusion list. On the other hand, more eco-friendly materials can also be stimulated. In this case, the

	environmental harm of materials is calculated and scored, giving an incentive to use products with a lower environmental harm. Apart from substitutive materials, new business models can also be requested, for example by requesting take-back schemes for products.
	4.5.6 Sharing No criteria which stimulate the aim sharing have been found in the tender guidelines and literature.
	4.5.7 Optimising Paragraph 3.5.7 showed that currently a lot of energy and water is wasted due to inefficient use. Appendix 10.3 includes tender criteria to optimise the heat, energy, water, and material use of the building. The easiest way to optimise the use of resources is to set a limitation, for example a minimum insulation value or a maximum energy use. In the case of window frames, requesting minimising heat leakage during use was found to be the most impactful criterion regarding energy use during the total life cycle (Tarantini et al., 2011). This means that due to the long lifetime of buildings, minimising resource use during operation is one of the major factors to minimise energy use. In the case of building materials, a prolonged warranty may lead to higher quality materials, leading to lower material consumption during use.

4.6 Conclusions

The second part of the theoretical framework addresses the subject of land tendering, to answer the sub-questions:

2. What is land tendering?
3. How can circular economy aspects be integrated in a land tender?

4.6.1 What is land tendering?

Land tendering is the act where a government sells land to a market party, using tender allocation to select a party for the development. Next to using selection based on price, quality aspects are increasingly used in these tender processes. Due to the fact that research towards land tendering is limited, the subject is broadened towards public procurement. This includes a study on how governments use quality aspects to select a proposal.

Public procurement gives the opportunity to select on quality aspects where, circularity can be incorporated as one of these quality aspects. Experience with circular public procurement (CPP) is limited. There already is quite some experience with sustainable public procurement (SPP). Here, the quality criteria are set to achieve the sustainability policy of the municipality by setting criteria which relate to this policy. The concept of SPP can be transformed towards circular public procurement, where CE criteria are used to assess tenderers. Often, some circular criteria are already incorporated in SPP and procuring departments deploy CPP without consciously knowing it.

4.6.2 How can circular economy aspects be integrated in a land tender?

Four different tender phases are distinguished where circularity must be integrated. The preparation, selection, awarding and assessment phase. During the preparation phase, circularity must be integrated in the project specific goals. Therefore, when a municipality has CE policy in place, these goals can be retrieved from policy goals. From these tender goals, a tender request must be written. This includes the demand of the municipality, together with the assessment criteria.

These assessment criteria are used to assess the tender proposals in the selection and awarding phase. In the selection phase, the number of tenderers can be narrowed, by using circular criteria to select tenderers who have a similar vision regarding circularity. In the awarding phase, the winning proposal will be selected. More detailed criteria can be used here to assess the proposals. Most of these criteria will be qualitative but the procuring party should quantify as much as possible, sometimes with a qualitative substantiation. Overall, these criteria are meant to award the most circular proposal in a way that best suits the CE vision of the procuring party. Paragraph 4.5 discusses some tender criteria that can be used to pursue the previously determined circular city aims. The main takeaway is that the procuring party should be aware about what they want from the beginning. This must be incorporated throughout the steps of the procurement process.

Case study research

Circular land tendering in practice

5 Case studies

This part describes four case studies on land tenders where circularity was included. *Table 5* gives a short overview of the specifications of each case. All the tender requests require tenderers to propose a multi-use building with facilities or commercial area on the ground floor and, among others, housing on the floors above.

Table 5: Overview of the cases studied

	Amsterdam: Kop Zuidas	Amsterdam: Kavel 14-01	Rotterdam: Delftseplein	Utrecht: HUQ
Max floor area	24.000 m^2	7.500 m^2	41.000 m^2	70.000 M^2
Functions	- Offices - Amenities - Housing - Parking	- Housing - Amenities (social, offices) - Parking	- Housing - Offices - Hotel possibility - Sharing facilities	- Housing - Commercial - Cultural functions
Circular criteria	Part of sustainability Make specific, BREEAM certificate	GPR & MPG score & qualitative justification	BREEAM certificate specified	Part of sustainability, contribution to CE
Weight criteria	15% sustainability	40 – 50% circularity	30% sustainability	~ 10% sustainability

Circularity is incorporated differently in each tender. In most tenders, it is part of the sustainability goals and criteria. Only in the case of Kavel 14-01, circularity is made a specific goal and specifically assessed. For each case, the circular building goals are studied on three levels:

- Policy: Municipal policy which focuses on circular building through land tendering
- Tender request: The goals and tender criteria formulated by the municipality
- Tender proposal: The response of the real estate developer

These three levels are described for each case among the tender process in figure 10. In appendix 10.6 - 10.9 more elaborate case descriptions can be found.

Figure 13: Tender process

The first paragraph discusses the municipal policy which was available during the tender. A policy review is done based on literature found in the process described in paragraph 2.2.3. The aim of this policy review is to get an understanding of the aims of the circular policy and evaluate if these aims correspond with the aims of the tender request and tender proposal.

After the municipal policy is addressed, the next paragraph discusses the goals in the tender request. The following paragraph discusses the elaboration of the tender goals into tender criteria. To acquire information on tender goals and criteria, the tender documents issued by the municipality are the main source of information, complemented with information provided by municipal officials in the interviews.

The next section will discuss the tender proposal which was issued by the tenderer. To study the proposal, the bidbook is studied and an interview with the real estate developer is conducted. The interview protocol for this interview can be found in appendix 10.2.

Finally, the building contract is discussed. It was not possible to review the contract in the cases but some information on the contract was retrieved in the interviews. This information is discussed in this paragraph.

5.1 Amsterdam: Kop Zuidas

The Zuidas is a business district located around the southern part of the Amsterdam ring road. Currently, the area is a business district for the city of Amsterdam, which will change in the coming years. In the development plans of the municipality, it will turn into a more mixed-use neighbourhood with one million additional square meter of offices, housing, and amenities to be developed. The tender for 'Kop Zuidas' is positioned as the first part of this larger development (Gemeente Amsterdam, 2017d).

The tender request was put out in the market in 2017. The tender brochure (Gemeente Amsterdam, 2017d) describes the Kop Zuidas-project as a part of the area development. The project must interact with a small-scale residential neighbourhood on one side and larger scale buildings next to the highway on the other side. This connection should be visible in the architecture and programme of the building, as a mixed-use programme. A maximum of 24.000 m^2 is allowed at the location, with functions of offices, amenities, housing, and parking.

5.1.1 Municipal Policy

Amsterdam has an extensive amount of policy regarding circularity. The municipality wants to be one of the frontrunners regarding CE (Gemeente Amsterdam, 2015a). To realise this ambition the current municipal CE policy is mainly focussed on knowledge development (Gemeente Amsterdam, 2016a; Gemeente Amsterdam, 2016b).

Amsterdam is pioneering in circular building with a roadmap circular land tendering (Roemers & Faes, 2017). This roadmap was constructed to come with a plan to make circularity measurable, stimulate circular design and construct a step-by-step-plan for the land tendering department (commissioned advisor, personal communication, April 23, 2020). The roadmap concludes with a set of criteria which can be used in tender requests (Roemers & Faes, 2017). The roadmap gave reason to start four tenders in the city to experiment with the principles from the roadmap.

5.1.2 Tender request goals

The tender request was put out in the market in 2017 with the goal to develop a mixed-use building, that meets the demands on sustainability, housing for youth and elderly and amenities. The goals regarding sustainability were formulated based on the sustainability vision of the municipality, and a drawn-up vision for the area development. This latter document mentions some specific measures which can be used in tenders, such as BREEAM certifications, a minimum floor-to-ceiling-height, and the use of the city heat network (Gemeente Amsterdam, 2016c). Apart from this area development vision the roadmap circular land tendering was supposed to be used as input for tender goals (Roemers & Faes, 2017). However, the process of goals formulation was too advanced when the roadmap came out and the roadmap was not used (sustainability advisor Amsterdam, personal communication, February 18, 2020).

The area vision and Amsterdam sustainability vision were translated into project specific goals. Regarding the CE, these goals are limited to using as little virgin materials as possible and loop materials as long as possible (Gemeente Amsterdam, 2017a). Additionally, there are sustainability goals. For example, rainwater storage, green roofs, and sustainable mobility, which also contribute to a CE.

5.1.3 Tender request criteria

The defined project goals are translated into tender criteria listed in table 6. The goal of a mixed-use programme is translated into a criterion for a programme. Circularity and sustainability are merged in a sustainability criterion. In addition, the quality criterion refers to architectural quality, and the organisation profile describes the capability of the tenderer.

Table 6: Tendercriteria Kop Zuidas

Selection phase		Awarding phase	
Organisational profile	15 %	Programme	30%
Concept & Programme	40%	Design	40 %
Quality	30 %	Sustainability	30 %
Sustainability	15 %		

Regarding the sustainability criteria in the selection phase, the municipality requests tenderers to write a two-page vision regarding sustainability. In this vision, the municipality challenges tenderers to focus on circular building, sustainable mobility & innovation (Gemeente Amsterdam, 2017d).

In the awarding phase sustainability is assessed more elaborately. One third of the points for sustainability can be earned with a BREEAM certification, where the minimum requirement is set at a BREEAM Excellent certificate. The remaining points for sustainability can be earned with an elaboration of the sustainability vision from the selection phase. Tenderers are requested to make their proposals as quantifiable as possible. For this elaboration, a list of minimum contents is provided. This consists, among others, of the extent to which a circular construction and sustainable mobility have been implemented, and the extent to which ambitions have been quantified. By requesting a quantification of the ambition, the municipality can qualitatively assess quantitative numbers. These numbers can then be incorporated into the contract.

5.1.4 Tender proposal

The winning tender proposal is the building 'CrossOver', an energy neutral mixed-use building with green rooftop gardens in a mix of housing, working, learning, and sharing. The residential programme focusses mainly on starters and residence permit holders, who live in studios and share co-living space. (AM, Team V, Valstar Simonis, DGMR, & Pieters Bouwtechniek, 2020).

The municipal request to quantify sustainability as much as possible has been translated into three points for circularity (AM, 2017):

- 40% circular materials (construction materials are secondary or bio-based)
- High extent of prefab (to prevent waste)
- 98% materials reusable after deconstruction

Along with these points, some specific measures were given in the bidbook for implementation. For example, circular facade bricks. The project developer states these measures could be taken because of the weight of 30% on circularity, which gives room to invest in, for example, these circular facade bricks (personal communication, March 3, 2020).

5.1.5 Building contract

The project developer admitted that some of the proposed solutions were not found to be feasible during later stages (personal communication, March 3, 2020). An example of this is the bricks in the facade, which were made of recycled ceramic

	waste. Due to a lack of certification of these bricks, it was agreed with the municipality that it would be better to replace these bricks with common bricks. The project developer stated that in these cases it is preferable to continue the dialogue with the municipality. It is in the interest of both parties, the developer and municipality, to choose bricks that last for a long period. In this case, the solution of recycled bricks was 'soft' in the contract. However, the percentage of 40% circular materials is a hard number, which is incorporated in the building contract. If the bricks were replaced with a non-circular alternative, this must be compensated in another aspect of the building. Although the promise of 40% circular materials is incorporated as a hard number, it can be difficult to check and control if this is achieved. The municipality and project developer are still searching for suitable ways to prove that the hard criteria have been met (project developer, personal communication, March 3, 2020).

5.2 Amsterdam: Kavel 14-01

'Centrumeiland' is a new artificial island in the IJ-lake in Amsterdam. The island is part of a new neighbourhood, consisting of six islands of which Centrumeiland is the largest. 'Kavel 14-01' (Plot 14-01) is the entrance building of the island. The tender prescribes a building with rental apartments and local facilities on the ground floor. This tender distinguishes itself from the other tenders because it specifically assesses circularity.

5.2.1 Municipal policy

The policy is equal to policy for the tender of kop Zuidas, discussed in paragraph 5.1.1. The difference with the tender for Kop Zuidas is that the 'roadmap circular land tendering' was used for this tender.

5.2.2 Tender request goals

The goal of the tender on Kavel 14-01 is to add rental dwellings on Centrumeiland. The building is located at the entrance of the island, which should be reflected in the quality of the architecture (Gemeente Amsterdam, 2017f). This tender is one of the three pilot tenders for the roadmap circular land tendering. However, Kavel 14-01 is the only tender where this policy is explicitly used (sustainability advisor Amsterdam, personal communication, February 18, 2020). The municipal project manager ground & development (from now on project manager) explained that due to the fact that this tender was a pilot project for the roadmap, circularity was strongly incorporated in the tender (personal communication, March 13, 2020). However, the influence of the roadmap was limited. The roadmap gave criteria which were found often too specific to request in a tender. In addition, too many goals were listed in the policy, which could not all be incorporated in the tender. Therefore, consultants were hired to formulate tender criteria together with the municipal project team (personal communication, March 13, 2020).

5.2.3 Tender request criteria

The main goals of kavel 14-01 are the architectural quality and circularity, these are supplemented with a financial criterion, as shown in table 7.

Table 7: Tendercriteria Kavel 14-01

Selection phase			Awarding phase		
Circularity	Vision	15 %	Circularity	GPR score	15 %
	Reference projects	10 %		MPG score	15 %
Architectural quality	Vision	40 %		Explanation	10 %
	Reference projects	10 %	Architectural quality	Design & explanation	40 %
			Financial	Price	20 %

Table 7 shows that circularity criteria are incorporated in the selection and the awarding phase. In the selection phase, tenderers are required to write a general vision on circular building. The more specified and ambitious the vision is, the higher the score. Secondly, tenderers must specify which materials they want to use in the design, and state why these materials are circular. Tenderers must also specify the percentage of materials that are renewable and what percentage can be recycled after use. The higher the percentage and the more plausible it is that these percentages can be realised, the better they score (Gemeente Amsterdam, 2017f). Although tenderers had to specify these criteria, they were not used further on in the

tender process. The municipality steered the tenderers with criteria from the awarding phase (Project manager, personal communication, March 13, 2020).

In the awarding phase, a qualitative explanation on the circular measures is requested. Tenderers must explain how circularity is integrated in the design. Additionally, two quantitative criteria are used:

- GPR score: measures sustainability performance, where the municipality chose to focus on energy & materials.
- MPG score: measures environmental performance of materials

The main argumentation to choose for these criteria is that these are enforceable during the construction phase. An MPG score must be calculated for the construction permit, so the extra costs for tenderers are limited (project manager, personal communication, March 13, 2020). However, the project manager also mentions a dilemma in enforcing these criteria. Enforcement can lead to a delay in the project, which is undesirable in the viewpoint of constructing housing and the disturbance it will give to neighbours (personal communication, March 13, 2020).

5.2.4 Tender proposal

The tender was won by the proposal of 'Juf Nienke' (Teacher Nienke). It was not possible to get any information from the developer concerning this plan, but one of the other tenderers did provide information regarding the motives and means to participate in the tender. Therefore, a different plan is discussed in this case description.

The proposal for the building 'Cirkelstad' was made by a consortium of a real estate developer, architect, contractor, and sustainability consultant. These parties were motivated to participate in the tender because circularity was one of the goals. They wanted to learn about circularity in this tender (project developer, personal communication, March 24, 2020). The sustainability advisor in the project team was considered as an extra, since normally the sustainability advisor would not be hired. The goal of this extra advisor was to create the best results on circularity (project developer, personal communication, March 24, 2020).

All circular plans for the building were made in a brainstorm. Here, team members shared experiences and ideas. As a consequence, team members had a lot of influence on the final measures of the proposal. Besides that, measures were mainly impacted by (project developer, personal communication, March 23, 2020):

- the building envelope: The strict envelope made standardized modular elements difficult.
- the fixed ground price: Circular development is riskier than regular development, making price calculations volatile.
- the long time span between tendering and construction: In for example the search for a donor building.

These three aspects can all be interpreted as risks for the developing party, where a developer has an interest to keep risks as low as possible. From a developing perspective the increase in risks can be a barrier for CE development.

5.2.5 Building contract

In the contract for Kavel 14-01, the tender proposal is added as appendix, together with the MPG and GPR scores to enforce circularity. The two quantitative scores are hard number which must be met. The tender proposal is regarded as preliminary design and can change during further development, as long as the general design stays intact (project manager, personal communication, March 13, 2020).

5.3 Rotterdam: Delftseplein

Delftseplein is the plot adjacent to the Rotterdam central train station, in the Rotterdam central business district. Within this district various developments are planned by the municipality. The municipality wrote a vision on how the tender for Delftseplein should function within this area development (Gemeente Rotterdam, 2017). The tender was run in 2019 for a building programme of 41.000 m^2. This is supposed to consist of housing and offices, with the possibility of a hotel. Additionally, the municipality wants to challenge the tenderers to think of functions which are shared by the users of the building.

5.3.1 Municipal policy

Rotterdam has published several policies and visions on the CE. These formulate the municipal goals, actions, and key-sectors for a transition towards a CE. The level of elaboration differs per goal, action, and sector. In general, there is a focus towards looping activities in the public area, since the department for city management is responsible for formulating and executing CE policy (sustainability advisor, personal communication, March 19, 2020).

The policy 'van zooi naar mooi' (from mess to beauty) mentions the construction sector, among other sectors, as key sector for the transition to a CE. It identifies four actions for the municipality (gemeente Rotterdam, 2019b):

- Use material passports for buildings.
- Sign a circular concrete covenant.
- Extend construction hubs for material looping.
- Digital marketplace for material looping.

Although these actions cannot directly be implemented in a land tender, these can be used as guidelines on the goals of Rotterdam regarding circular construction. With a shortage of other - more specific - policy, CE goals must be identified per tender.

5.3.2 Tender request goals

When the tender for Delftesplein was initiated, there were no sustainability goals formulated (sustainability advisor, personal communication, March 19, 2020). A municipal sustainability advisor was able to restart the tender process and incorporate sustainability, with the support of a director (personal communication, March 19, 2020).

With a restart of the tender process, the tender goals were based on the urban area vision. This vision formulates three ambitions, which are incorporated in the tender: connect, share & sustain (Gemeente Rotterdam, 2017a). These ambitions remain vague but are made more specific in the tender vision of the municipality. Regarding circularity the municipality formulated three ambitions (Gemeente Rotterdam, 2017a):

- Design for life expectancy: Think about the adaptability of a building so it is easy to change functions.
- Design for substantiated sources and destination of materials: Maximise reuse of materials and gain insight in material footprint in not only during the construction cycle, but also in the future material cycles.
- Use of material passport: Support the first two ambitions.

In addition to these three ambitions, CE aims can be found in other formulated goals. The municipality has for example formulated the goal of an energy neutral building and water saving facilities. These ambitions were specified with a team of 10 people from the municipal engineering department. All were involved with different aspects of sustainability (sustainability advisor, personal communication, March 19, 2020). The lack of policy made that engineers were free to incorporate criteria they though

were important, without consistency with other projects. The sustainability advisor of the project team describes for example to have read about material passports as a good solution for circular buildings and is able to incorporate this in the tender (personal communication, March 19, 2020).

5.3.3 Tender request criteria

The formulated ambitions for Delftseplein are categorised in the four criteria in table 8. The 30% weight for sustainability is found to be extraordinary in Rotterdam because normally sustainability is assigned a weight of around 10% in tenders. Since the sustainability advisor had support from management to incorporate sustainability in the tender, he was able to increase this percentage (personal communication, March 19, 2020).

Table 8: Tendercriteria Delftseplein

Selection phase		Awarding phase	
Spatial vision	20 %	Spatial & functional design	40 %
Conceptual vision & mix of programme	30%	Sustainability	20 %
Sustainability	30 %	Collaboration partner	10 %
Collaboration partner	15 %	Financial bid with substantiation	30%

As part of the sustainability criterion in the selection phase, tenderers must write a vision regarding sustainability which involved at least the four ambitions of the municipality: future proofness, circularity, the energy concept, mobility and the building method (Gemeente Rotterdam, 2019a). The assessment is then done based on three aspects:

- A minimum of a BREEAM Excellent certificate, and how this certificate is achieved.
- The extent of specification and realistically elaborating the mobility transition in the proposal.
- The future proofness of the building: This includes the flexibility of the building to adapt to future demand changes.

Regarding the first aspect, a BREEAM Excellent certificate is a required minimum. Subsequently, the team of 10 people from the engineering department have selected a list of 40 BREEAM criteria which are found important. When tenderers score high on these criteria, they score better in the tender assessment (Gemeente Rotterdam, 2017a; sustainability advisor, personal communication, March 19, 2020). The assessment of the other two sustainability aspects is done more qualitatively, where proposals score better when they meet the goals to a further extent.

5.3.4 Tender proposal

The tender for Delftseplein was won by the tender proposal for the building 'Treehouse': a 140-meter-tall tower, with a hybrid construction made from wood with a concrete core. The building consists of 275 houses and 15.000 m^2 commercial floor area. The architect's aim is to design a building at the forefront of architectural sustainability with the sustainability measures taken in the building (PLP Architecture, n.d.).

The tender request by the municipality was received very positively by the project developer (Project developer, personal communication, March 26, 2020). The BREEAM certification is perceived as a good tool for guidelines on sustainable building. In addition, the 40 BREEAM criteria gave direction for desired solutions: these criteria could be incorporated in the building design by giving them to sustainable

	consultants to find the most suitable solutions (Project developer, personal communication, March 26, 2020). The three circular ambitions formulated by the municipality (design for life expectancy, design for substantiated sources & destination, and material passports) are also addressed in the bidbook of the proposal (Provast, 2019). Flexible office areas are a response to the request for future proof buildings and a guarantee is given on 80% verifiable responsible materials and a material passport is promised. Additionally, the requirement to incorporate circularity in the sustainable vision led to a study on circular material use. A preliminary study has been conducted to a donor building, and which materials can be reused (Provast, 2019). Overall, the project developer aimed to incorporate an answer to the 40 BREEAM criteria. Some numbers have been quantified, although not specifically requested, to convince the municipality. The focus in the proposal is on qualitative measures for the building, such as reusing certain materials.
	5.3.5 Building contract The building contract has not been checked with the tender commission, and thereby not with the municipal advisor responsible for sustainability (personal communication, March 19,2020). This might suggest that a standard contract is used, in which circularity, or sustainability in general, is not strongly incorporated. The project developer mentions that circularity in the contract is mainly documented in the request and the proposal, which are both an appendix to the contract. The project developer mentions that it is possible to deviate from the bidbook during the development process, but this requires a substantiated reason why the initial plan is not feasible (personal communication, March 26, 2020). An exception to this rule of deviation is for example the BREEAM Excellent certificate, which was part of the tender requirements by the municipality. This is a hard norm that must be met by the tenderer.

5.4 Utrecht: HUQ

The Healthy Urban Quartier (HUQ) in Utrecht is part of the 'Beurskwartier' or 'Stationsgebied', an area development next to the central station in Utrecht. The area development should connect both sides of the train station. The tender for HUQ consisted of a plot with a maximum floor area to be built of 54.000 m^2. This could be filled with functions such as housing, commercial and cultural functions. (HUQUtrecht, 2016).

5.4.1 Municipal policy

Circular building is defined as a policy goal in Utrecht as early as 1993 (Gemeente Utrecht, 1993). However, after 1993 CE policy formulation on a municipal level was limited up to 2016 (developer circular economy, personal communication, March 20, 2020). A letter was sent to the municipal council, formulating three focus points regarding a CE:

- Circular procurement.
- Collecting: from waste to material.
- Circular construction and demountability.

Circular land tendering applies to circular procurement and construction, but no policy is available specifically on this subject. Later on, after the tender for HUQ ran, Utrecht has formulated policy more specific on the procurement of buildings (Gemeente Utrecht, 2018).

Therefore, the area specific policy was more relevant for the formulation of the HUQ tender. This policy formulated the goals for a green, healthy, sustainable and innovative district (Gemeente Utrecht, 2017a). The tender for HUQ was used as a trial to test how the ambitions for the area development could be translated to a building level (project manager, personal communication, March 6, 2020). A specific CE study was done on the urban area. In this study, the looping of construction materials was, among others, found as an opportunity (Marco.Broekman & Lint, 2017). This was made more specific with a study on the building materials which will come available from building demolitions in the area (Hofman & Rens, 2018).

5.4.2 Tender request goals

The main goal of the municipality was to apply the ambitions of the area vision on a tender in the area (project manager, personal communication, March 6, 2020). The ambitions of this area are green, healthy, sustainable, and innovative. With the request for HUQ the municipality wanted to inspire project developers to create a building which stimulates healthy living (project manager, personal communication, March 6, 2020).

5.4.3 Tender request criteria

In the HUQ tender there is a clear distinction between criteria focusing on the quality of the building and a criterion for the price. Table 9 shows the different criteria. An overall weight is given to the quality criteria instead of subdivided weights for quality aspects. These mutual weights were defined by the municipality, but were kept confidential towards tenderers (project manager, personal communication, March 6, 2020).

Table 9: Tender criteria HUQ

Selection phase		Awarding phase	
Vision on concept, programme & sustainability	65 %	Spatial vision (design / contribution to municipal vision)	75 %
Spatial vision (architectural)		Functional quality (mix / attractiveness plinth)	
Vision on collaboration & participation		Collaboration and participation	
Indicative land value with substantiation	15 %	Financial bid	10%
		Financial substantiation	15 %

In the selection phase, tenderers are requested to write a 10-page document explaining their vision for the plot. Per criterion the municipality has prepared a set of questions which must be answered by the tenderers in their proposal. These visions are assessed based on their contribution to the ambitions for the area and the goals of innovative, healthy, sustainable, and green living (Gemeente Utrecht, 2016a). The criteria for the awarding phase are similar to the selection criteria. In this phase, the vision from the selection phase must be worked out towards a sketch design, where specific requests are shared in dialogue sessions between tenderer and municipality (Gemeente Utrecht, 2016a).

The tender for HUQ differentiates itself from the other case studies by requesting a quite abstract vision from the market. This must be answered in a very qualitative manner. In the other tenders, the requirements per tender criterion were more predefined and qualitative criteria were complemented with quantitative criteria. The project manager states it was an explicit choice to focus on qualitative criteria to get intrinsic better buildings. The municipality wanted to prevent assessing tenderers based on assumptions, which are necessary for quantitative criteria. Instead, the municipality wanted to assess on the tenderer's vision and motivation to create the best fitting building. Reflecting on the tender process, the project manager still supports the qualitative assessment. However, the broad spectrum of ambitions made it difficult to excel in one of the ambitions (Project manager, personal communication, March 6, 2020).

5.4.4 Tender proposal

The tender was won by the plan for Wonderwoods, a building which distinguishes itself by the lush greenery on the facades and rooftop. This greenery is the most eye-catching element of the building and a lot effort has gone into designing this. The building consists of two towers, which together house close to 300 apartments and almost 25.000 m² of commercial area.

When the tender request was published, the real estate developer participated because they wanted to build an iconic building in the city of Utrecht (Project developer, personal communication, March 27, 2020). The development process started with the search of an architect. An image of a building in Milan was included as reference in the municipal ambition document. The director of the development company knew the architect of this reference building, thus the same architect was asked to join the team for the tender and make a similar building (Project developer, personal communication, March 27, 2020). Apart from this architect, a project team was put together with another architect and a consultancy firm. Both these firms were more often collaboration partners of the development company.

	The municipal vision for a healthy, sustainable & green area was leading in the development, together with the building concept by the architect. At the same time the developer aimed to answer each document which was provided in the tender request with an answer (Personal communication, March 27, 2020). Therefore, the municipal CE vision is answered with a CE vision for the building. In this CE vision, the layers of Brand are used and measures per layer are listed. These measures are mainly effort based. For example, the effort to minimise virgin materials or the aim to use biobased materials. Additionally, the proposal's CE vision describes how the commercial area is easily transformable into housing (Wullink, 2017).
	5.4.5 Building contract Circularity is only incorporated in the contract as part of the tender proposal and jury assessment, which are included as an appendix (project manager, personal communication, March 6, 2020). Consequently, circularity is incorporated as informal agreement. The building that will be constructed must be in line with the ambitions in the bidbook, but one should also understand that room for changes is necessary (project developer, personal communication, March 27, 2020). In cooperation with the municipality and the project developer the building plans are further developed. This was also part of the proposal, which incorporated S-teams. In these teams, the municipality and project developer could collaborate and further work out the sustainability aspects (personal communication, March 27, 2020). A downside on these qualitative agreements is that there is room for interpretation and the interpretation of the municipality can be different from that of the project developer (project developer, personal communication, March 27, 2020). A more specific tender agreement could help both parties to understand what to expect from each other.

5.5 Cross case analysis

To get an understanding of the effect of CE policy and circularity in tender requests, the cases are compared. The next sections discuss the differences between the cases, together with how these can be explained.

5.5.1 Municipal policy

On the topic of policy towards circular land tendering, the cases can be divided into two categories. In Amsterdam there was policy specific for circular land tendering, in Rotterdam and Utrecht there was no such policy available.

In the first cases, where policy for circular land tendering was available, the influence of the policy was limited. Although the land tendering policy offered specific tender criteria, the list of criteria was found too extensive and not directly applicable for incorporation in a tender. Policy should formulate the specific goals and corresponding criteria, together with guidelines on which criteria can be used. This last thing can for example be done with setting specific area ambitions.

There were two cases where there was no policy towards circular land tendering. In these cases, circularity was incorporated in the tender due to motivated municipal officials. The absence of circular land tendering policy is found to be a void because:

- Circular ambitions are only realised when there are municipal officials motivated to incorporate circularity.
- With the absence of circular tendering policy, it can be more difficult for officials to incorporate circularity.
- There are no guidelines on which circular ambitions should be realised on the plot.

Overall, there is a demand for municipal policy which formulates the circular goals in land tendering and gives guidelines for the implementation. This demand is also present on the real estate developer side, who desire clearer formulated goals from the municipality. This will make it easier to respond to the municipal goals in the tender proposal.

5.5.2 Tender request goals

All the tenders have been assessed on what extent they make circular solutions possible, by the framework of van Haagen (2018) in Appendix 10.4. The outcome is visualised in table 10, where an overview is created of the different tender requests on the different assessment criteria. Tenders can score on five levels, ranging from '- -' to '+ +'.

Table 10: *Procurement process possibilities assessment of the four cases compared*

		Kop Zuidas	Kavel 14-01	Delftseplein	HUQ
Preparation	Formulate a company-wide vision	+ +	+ +	+ +	-
	Translate company-wide CE vision in project specific goals	-	+	-	-
	Open & functionally specified tender	+ +	+ +	+ +	+ +
Selection phase	Circularity as exclusion ground	+ +	++	+ +	+ +
	CE vision request as selection criterion	-	+/ -	-	-
	CE assessment in reference project	-	+ +	- -	- -
	Dialogue and meeting	+	+ +	+	+

		Kop Zuidas	Kavel 14-01	Delftseplein	HUQ
Awarding	Combine qualitative & quantitative criteria regarding CE techniques	+ +	+ +	-	+/ -
	Combine qualitative & quantitative criteria regarding CE process	- -	- -	- -	- -
Assessment	Tender Assessment	+ +	+	+ +	++
	Circular criteria assessment	+	+ +	+	-
	Quantitative & qualitative price assessment	- -	- -	-	+

In the overview in table 10 there are some aspects which stand out:

- Kavel 14-01 made circular measures possible to the highest extent from all the cases. Only in the assessment phase other tenders score higher than Kavel 14-01.
- Although Amsterdam and Rotterdam had policy regarding CE, they did not translate this in project specific CE objectives for Kop Zuidas and Delftseplein. This may be because the policy did not provide specific information on circular building or circular land tendering.
- On a few themes all tenders score the maximum. It can be concluded that the subjects of requesting an open tender and not excluding based on circular experience are well represented.
- On only one criterion all tenders score the minimum, none of the tenders had criteria in place regarding CE process.
- Scoring tends to be done quite qualitatively. In all cases tenderers are requested to deliver a vision regarding sustainability or circularity and all tenders have qualitative criteria in place.

On many aspects the tenders could score better in the tender assessment form if circularity is requested more specifically, and not as a subject within sustainability.

To improve land tenders, three to four quality goals should be formulated per tender. These could be architecture, programme, etc. Circularity must be one of these goals, to stimulate tenderers to come with circular solutions. The specific focus towards circularity is currently often missing. In the absence of specific circular land tendering policy, goals are formulated based on the preference of municipal officials. By formulating goals that are retrieved from policy, it will be ensured that tenders contribute to the policy goals.

5.5.3 Tender request criteria

Tender goals must be translated into tender criteria. Tender proposals will be assessed based on these criteria; therefore, these criteria have a big impact on the proposals.

In the case studies, the weight of the criteria ranges from ~ 10% for sustainability to a weight of 40% - 50% specifically for circularity. It was found that a weight of 30% is advised to lead to substantial changes in the proposal. This allows developers to make investments in time and money to make the tender proposal more circular and thereby result in CE consultants who are hired from the start of the process to incorporate circularity in the building plans.

In the studied cases, only circular criteria towards technical aspects of circularity were found. None of the tenders had circular process criteria in place. The criteria

towards the technical aspects of circularity can be split into two categories: qualitative and quantitative criteria. The qualitative criteria are concerned with requesting a vision regarding the circularity of the tender proposal. In this vision tenderers can substantiate how they regard the CE and the contribution of their plan to a CE. Quantitative criteria are more constraining towards tenderers: they must submit a certain score. However, the quantitative score can be incorporated as hard number in the contract, forcing the tenderer to realise their ambition. In table 12 all the used criteria are listed, together with their pros and cons as stated by different municipal officials.

Table 11: Circular tender criteria with strengths and weaknesses

Criterion	+	-
Qualitative vision	• Gives freedom to tenderer	• Easy for tenderers to promise a lot, which they do not realise
Qualitative vision with quantification	• Gives freedom to tenderer	• Can be difficult to compare tenderers
MPG score	• Score to measure environmental impact	• Requires a lot information in tender phase • Still in development
EPC score	• Scores building's energy consumption & production	• Only scores energy
BREEAM score	• Widely used certificate in construction	• Prescribes specific measures instead of scoring result

There are two beliefs among the municipal officials regarding criteria. One side believes more in quantitative criteria to objectively assess different tenders on comparative aspects. The other side believes more in qualitative criteria, where tenderers can substantiate their beliefs. It is believed that circularity is not yet advanced enough to request quantitative criteria. The response to quantitative criteria will often be based on assumptions, which may not always be as objective as they seem. Therefore, there is consensus that a qualitative explanation is always necessary in circular tender criteria.

5.5.4 Tender proposals

The real estate developers in all the examined case studies state that they distinguish themselves based on the quality they deliver. Therefore, the focus on qualitative aspects in the tender request was a reason to participate. There were variations among the tenders: only in the case where circularity was assessed for 40%, the tenderer wanted to participate because of the circular goals. This means that if the weight of circularity is higher, tenderers with other motives will participate in the tender. On the other hand, all interviewed project developers stated that circularity is already part of their everyday life. They see that circularity is increasingly part of the tender requests and assignments by other clients. At the same time, all the circular measures in the building proposals were taken because there were circular criteria in place. If circular criteria are not established, developers will not earmark development budget to create a circular vision or incorporate circular plans.

If circularity, or sustainability, is not part of the tender request, there are some minimum requirements that are established by the market. Project developers state that for an office building, a BREEAM Excellent certificate is already the standard. When you develop without this certificate, it is more difficult to sell the building to an investor. This means that the added value of a request for a BREEAM Excellent certificate is negligible for office buildings, these will be required by the market

anyway. On the other hand, requiring a BREEAM Excellent certificate will ensure a minimum sustainability level, without requesting additional effort of the tenderers. It can therefore be used as minimum requirement.

The formulation of the tender criteria is an important aspect of the tender request, tenderers will mainly base their tender proposal on these criteria. Project developers prefer clearly defined project goals and criteria. these give support for the measures in the tender proposal. The formulated criteria will be communicated to subcontractors because this is also the framework in which they must deliver their work. Therefore, the formulation of tender criteria will have effect on the entire supply chain of the building. None of the interviewed developers seem to have a clear preference for any kind of criteria such as the incorporation of an MPG score or a qualitative vision. They will deliver what is requested by the municipality, as long as they perceive it as a feasible proposal. Although there is not a favoured kind of formulation, a combination of qualitative and quantitative criteria is found desirable.

On a general level, it is difficult to conclude which municipal goals and criteria have led to which measures in the tender proposals. In the tender of Kop Zuidas, tenderers were requested to quantify as much of their proposal as possible. Consequently, the tenderer quantified a percentage of recycled materials. In the tender of Delftseplein, specific BREEAM criteria were mentioned. The tenderer asked their sustainability advisor how these criteria could be integrated in the design. For the tender of HUQ, there was a municipal circular area vision available. This led to a circular vision on the building drafted by the tenderer. These examples all show how municipal requests can affect proposals. In the studied cases there were no examples of goals and criteria which were not answered by the tenderers.

5.5.5 Building contract

It was not possible to see any of the building contracts. From the interviews it can be concluded that circularity is often not strongly stipulated in the contract. Sometimes circularity was not incorporated in the contract, or the people responsible for sustainability did not get to see the building contract. In these cases, circularity must be enforced based on the tender proposal. This is included as an appendix to the contract, so all aspects in this proposal will become part of the contract. However, municipal officials and project developers agree that not all aspects of a building proposal must be implemented during construction. It can be seen as a framework agreement, where the bigger picture must be realised.

Where circularity is included in contract clauses, this is done because quantitative aspects were requested in the tender. A BREEAM, MPG, or EPC score can be incorporated as hard number in a contract, which functions as a threshold for the construction. Requesting this kind of scores is a good idea because it can make the enforcement of circular aspects easier.

5.6 Conclusions

The aim of the conducted case studies is to gain insight in how circularity is currently implemented in land tendering. By comparing the four cases an exploration is done on the policy level, the tender request, and the tender proposal. The following sub-questions are answered:

4. How do municipalities currently request circularity in land tenders?
5. How do developers respond to those requests?
6. Where can circular land tendering be improved?

5.6.1 How do municipalities currently request circularity in land tenders?

The amount of circular land tendering policy was found to be limited. In two of the cities which were studied, there was no policy available regarding circular land tendering. In these cities circular goals were established by the personal interest of municipal officials. In one municipality, policy towards circular land tendering was available. Here it was found that policy needs to be specific, regarding goals and implementation. Due to the fact that the circular land tendering policy did not match the demands from the municipal officials to draw up tender criteria, the policy did not reach the optimum effect.

In all the studied tenders, CE goals were formulated by the municipalities. In three out of the four studied tenders these goals are part of the sustainability criteria. In the other case, there are no sustainability criteria, only circularity criteria. The extent of goal specification varies per tender. The level of detail varies from: 'the goal that a building should be energy neutral' to 'a contribution to the circular economy'. In the translation towards tender criteria, it can be seen that it is easier to translate specific goals to tender criteria. In the case of the goal for energy neutrality, an EPC score, measuring the energy neutrality, is required. In the case of a contribution to a circular economy, a qualitative vision is required. This qualitative vision is more difficult to objectively assess, and harder to incorporate in the contracting phase.

Overall, circularity is included in tender requests. In most cases this is done as part of sustainability. The detail level of the circular goals is still limited, as most requests do not very specifically define the circular ambitions. However, there are some good examples. For example, setting a goal for energy neutrality, or the lowest environmental footprint of the used materials (MPG score).

5.6.2 How do developers respond to those requests?

Tender proposals are assessed based on the defined tender criteria. Therefore, real estate developers will try to design a building which is as much in line with the tender criteria as possible. If real estate developers sense that they are not able to accurately answer the tender criteria with a feasible business case, they will not participate in the tender. In their turn, municipalities will try to formulate their tender request in such a way that tenderers will come with proposals. For example, by verifying the tender request in a market dialogues previously to putting the tender on the market.

None of the municipal officials thought that tender proposals had missed out on certain aspects, which they would have liked to see in the proposals. However, this may also come because the challenges are not always clearly defined on the municipal side. This is also the biggest challenge for real estate developers. In the field of CE, tender requests are not always specific enough. A tender request which clearly defines the definition of a circular economy with corresponding goals helps tenderers to comply with these goals. Therefore, formulating clear goals can help to achieve these goals.

In all the four cases, the real estate developers stated that they took actions due to the CE criteria. The extent of changes varies per tender, developers state that a weight in the

tender criteria of around 30% is advised to lead to substantial design changes in the proposal. In this case, developers are able to invest time and money to win the tender. Only two tenders had a weight of 30% or more. Both had a construction which was designed in sustainable way. However, the project developer of one of these projects stated that it was not done because of the sustainability criteria, but to create an architectonic statement.

Apart from the tender criteria, the municipality can also influence proposals with the goals they formulate prior to the tender. In one case every municipal tender document was answered with a document in the proposal, leading to a vision on the CE in the building. However, the influence of these documents is smaller than that of the tender criteria, therefore municipalities must make sure their goals are anchored in the criteria.

In all the cases, consultants were hired to implement the circular aspects into the proposal. Project developers compose their project team based on the tender criteria to create a team which is best capable of fulfilling the criteria. The role in the team will also vary based on the criteria: the bigger the criterion weight, the bigger influence the corresponding consultant will have.

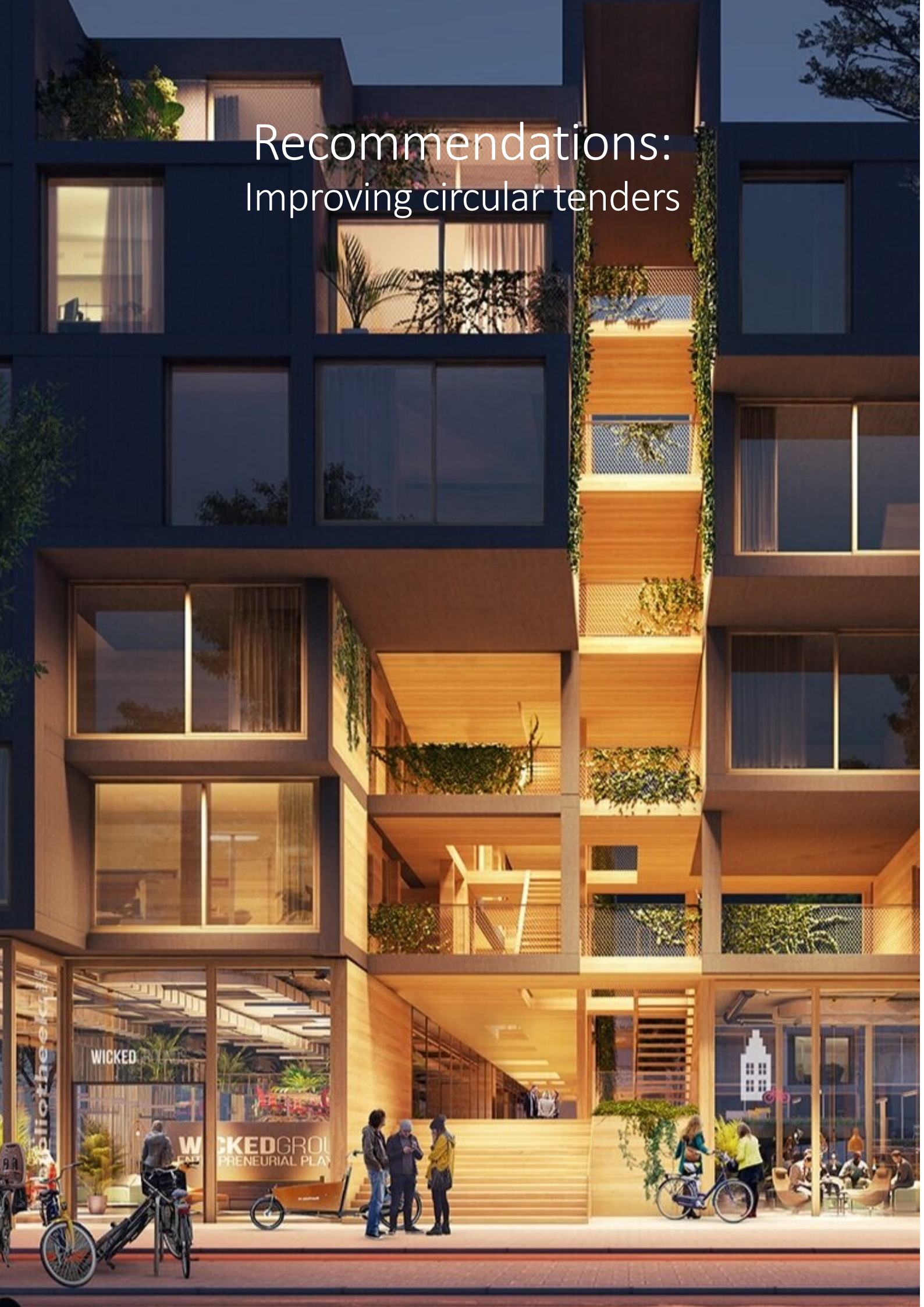
5.6.3 Where can circular land tendering be improved?

From the answers from the previous two sub-questions, together with the knowledge from the theoretical framework, two areas of improvement are identified.

First, the process of a circular tender. Policy on circular land tendering is not always present, or sufficient. Policy must better serve the goals of circular land tendering. At the end of the tendering process, the compliance with tender goals is not always verified. Therefore, the tender goals, or the translation into the tender criteria, must be included in the contract, and checked upon construction and operation.

Secondly, there is a demand for quantitative criteria which can be used to objectively assess tender proposals, and to check compliance in the construction phase. The currently used quantitative criteria, where an MPG score or BREEAM score is assessed, have weaknesses. For the calculation of an MPG score, too much information is needed, leading to a high number of assumptions which is made for the calculation. A BREEAM score is based on specific measures, instead of measuring the result. Therefore, a quantitative criterion which measures the circular result based on less information can improve circular land tendering.

Recommendations:
Improving circular tenders



6 Improvements for circular land tendering

Based on the findings from the case studies three improvements were designed: a process design to incorporate circularity in the tender, a criterion for circular material use, and a criterion for adaptive buildings. These three improvements were presented to seven experts in the field of circular tendering and construction. Based on these interviews, the improvements are refined. The following three chapters will each discuss one improvement, together with the remarks which were made by the expert interviews.

A choice was made to design criteria for circular materials and adaptivity: these aspects were listed multiple times under the circularity goals in the studied tender cases. This aligns with the CE aims by Williams (2019a), who says the aims of looping, adapting and regeneration are the core aims of a CE in a city. Energy was not included because it is often regarded as sustainability instead of circularity. Additionally, legislation on energy consumption of buildings is currently changing with BENG regulations. Therefore, it was chosen to focus on desired changes in the fields of circular materials (looping) and adaptivity.

6.1 Circular tender process design

A similar process was established for all the cases. Some cases encountered problems which were prevented in other cases. The process in figure 11 shows the steps which should be taken to deliberately incorporate circularity in the tender process.

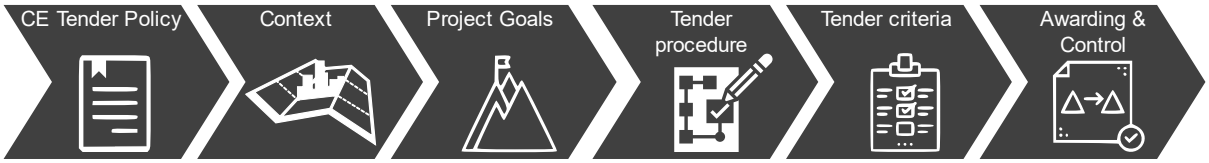


Figure 14: Circular tender process design

The process in figure 11 is not necessarily a sequential process, sometimes it might be necessary to move a step back. However, it is important to realise that all the steps must be taken in a circular tender. Therefore, one should realise the impact of decisions made in one a step on the steps which will follow. For example, policy will be the most effective if it can be incorporated in project goals, translated into tender criteria and enforceable in the awarding and control phase.

6.1.1 CE tender policy

Out of the studied cases, Amsterdam was the only municipality with CE policy specifically aimed at land tendering. In the other two municipalities, circularity was incorporated in the project goals because there were officials who showed commitment regarding CE incorporation. In these cases, policy regarding CE was helpful to convince other stakeholders of the importance of incorporating CE goals (personal communication, March 3, 2020), which was confirmed by experts (personal communication, April 24, 2020; personal communication, May 5, 2020). It is therefore advisable to formulate CE policy towards land tendering. This policy must contain three things: a long-term vision, a specified action plan to realise the vision, and assignment of responsibilities for execution (personal communication, April 21, 2020; personal communication, April 22, 2020; personal communication, April 24, 2020; personal communication, May 1, 2020).

The long-term vision in the municipal CE policy shows what the municipal definition is of CE, which is what the private sector can respond to. This vision shows the bigger picture of city-wide goals regarding CE, where the municipality also defines what a CE means for the municipality.

Aside from the long-term vision, it is important to implement this vision in the projects which are running. This is mostly done with an implementation plan, where specific projects are mentioned. Interviewees mention that this short-term implementation plan is often not specific enough, that the right people are not involved and that there is a lack of responsibility for the execution. Therefore, the implementation plan should consist of the following elements:

- Concreteness: All terms and goals should be specified, for examples on which projects the policy is applicable and how this is incorporated.
- Responsibility: The people who are responsible for the execution of the project should be involved with the implementation plan, to ensure the plan can be implemented and that the people involved feel the responsibility for implementation.

The organisational policy will not be drawn up for each tender but is a requirement before the tender can be run. The available policy is studied for each tender because some policies can be specific per location.

6.1.2 Context

During the expert interviews, the step of studying the context of the tender was added because one of the interviewees mentioned its importance. In this step, the specifics of the plot and the area are studied to define the challenges and the possibilities of the plot and how the tender can respond to these (personal communication, April 23, 2020).

For the formulation of CE goals, two aspects of the context must be studied. These are the context aspects may lead to CE criteria, and external aspects which may influence the criteria. Some examples of a context study which may directly lead to CE criteria may be:

- A search for demolition buildings, to study which materials can be reused. This was done in the case of the HUQ tender (Hofman & Rens, 2018).
- The problem identification that during heavy rainfall, the drainage near the train station in Rotterdam was not sufficient. Tenderers of Delftseplein were challenged to come with a solution for this problem (advisor transitions, personal communication, March 19, 2020).
- The presence of a heat net in Amsterdam was included as tender requirement in the tenders of the municipality of Amsterdam.

In addition to these CE aspects, external aspects may influence CE criteria as well. For example, the economic situation: in a prosperous economy more ambitious goals can be set (Kersten, Schroots, Amerika, & Bregman, 2019). All these context aspects must be taken into account before the project goals can be defined.

6.1.3 Project goals

When the policy and context is studied, the project goals can be defined. These project goals will be retrieved from the study on the policy and context. Next to defining goals, which will be translated into tender criteria to challenge the market to come up with the best solutions, minimum requirements can be defined. These requirements must be in each proposal and ensure a certain minimum quality level.

The minimum requirements in a tender procedure often regard the capability of a tenderer. This can be on two aspects, technical and financial capability. In addition to these requirements, minimum requirements can be defined as threshold before points of an awarding criterion can be scored. An example of this is found in the studied case of Delftseplein, where a BREEAM Excellent certificate was a minimum requirement to score points for sustainability (Gemeente Rotterdam, 2019a). The graduation research of Van

Haagen (2018) mentions to limit the number of minimum requirements regarding circularity, since market experience with circularity is limited which can lead to a depletion of possible tenderers. This is supported by one expert interview, who states that minimum requirement regarding the CE should be focussed on the energy consumption of the building (personal communication, April 21, 2020). The minimum requirements can also be used to decrease the number of goals translated into ambitions. One expert for example states that the urban context should be a requirement instead of an ambition (personal communication, April 21, 2020). This was also mentioned by a real estate developer, who said the 'aesthetic quality plan' of the city, which is used to assess the design in the permitting phase, should be sufficient to ensure the urban context is taken into account (personal communication, March 24, 2020).

The interviewees were asked how many goals should be incorporated in the tender. Answers varied from three to seven goals, where most answers were around four project goals. This number is slightly higher than the findings from the case studies, where two or three qualitative aspects in a tender were most often mentioned as optimum number. This illustrates that project developers favour less focus points, although both parties agree that the number of project goals should be limited. Additionally, fewer project goals will lead to more differentiation between tenderers. They do not have to incorporate all the goals but can distinguish themselves from the others on a few goals. This will make it easier to assess the tenderers (personal communication, April 21, 2020).

All expert interviewees agree that circularity should be made a specific goal in the tender. If circularity is a part of sustainability, they are afraid it will be lost in other, more common, sustainability measures. Some experts see that in the future, circularity should be integrated more with other aspects. They see that the holistic approach of circularity touches upon more project goals, but the market is not ready for this yet. One interviewee mentions that circularity could also be integrated in more project goals. For example, by looking how circularity can become part of the financial goals or how circular business models can be rewarded under the financial goals (personal communication, April 28, 2020). This is also part of the framework of van Haagen (2018), who says that tenders should be awarded based on life cycle costs.

6.1.4 Tender procedure

The step of selecting a tender procedure was added after two interviewees mentioned that it has important consequences in the tender process (personal communication, April 21, 2020; personal communication, April 28, 2020). A procedure where a dialogue is present should always be selected (PIANOo, 2019; van Haagen, 2018). However, there are multiple procedures where a dialogue is present and the chosen procedure can influence the tender criteria and process (personal communication, April 28, 2020).

According to the website of the Dutch green deal circular procurement, there are three frequently used forms procurement where a dialogue is in place (Green Deal Circulair Inkopen, n.d.):

- Competitive dialogue: A restricted procedure where a dialogue has been added between the selection and award phase. This dialogue offers additional opportunities for deepening the challenges or ambitions.
- Competitive procedure with negotiation: A restricted procedure in which, after the contract has been awarded, negotiations are conducted with the winning tenderer to arrive at a better proposal.
- Innovation partnership: For complex issues, where only one or a few parties can fulfill the request. The procuring party and tenderer develop together a product, which can be procured under conditions defined at the start of the partnership.

In addition to these frequently used procedures, there are multiple other procedures and tender methods which can be used. The most important thing is that the procuring party studies the various possibilities and chooses a method which suits their goals the best. It must be prevented that a method is selected because people are familiar with it (personal communication, April 28, 2020).

6.1.5 Tender criteria

The previously defined goals must be translated into criteria which can be measured in the tender assessment and enforced with the construction contract. Formulating these criteria precisely is important since the case studies showed the criteria formulation has the most impact on the tenderers, as they invest to score high on the criteria.

A distinction can be made between two different kinds of criteria: qualitative and quantitative. Qualitative criteria most often request a vision of the tenderer regarding the CE. This is sometimes made more specific with concrete measures in the building design. A quantitative criterion requests numbers from the tenderers, for example the environmental footprint of the materials based on an MPG score or a BREEAM certificate. In a qualitative criterion, the tenderer can always respond with quantitative numbers. However, in a quantitative request criterion, tenderers cannot respond in a qualitative way. All the experts of the interviews agree that both kind of criteria can be useful in a tender. However, there is a wide range of opinions among the experts on the extent of qualitative or quantitative criteria to be used in a tender.

The qualitative side of the spectrum argues that CE innovations move quickly, and a tenderer should be awarded on their vision on how to deal with these innovations. From this viewpoint, it is important to stay flexible during the development phase which sequels the tender and a tenderer is selected who is self-motivated to keep developing and keep ambitions high. Tenderers can be requested to make their proposals specific but are free to decide how they incorporate this. In the quantitative side of the spectrum, they believe is that qualitative criteria lead to greenwashing. Tenderers can write ambitious CE visions but are not able to realise this. Qualitative aspects are hard to translate into a contract, which makes it more difficult for the procuring party to enforce circular measures. From this viewpoint, a qualitative vision can be requested only as an addition. For example, to make a first selection of tenderers in the selection phase, or as substantiation. Subsequently, the awarding is based on quantitative criteria, potentially with a qualitative substantiation.

Overall, there is a shift from qualitative criteria towards more quantitative criteria. The industry and procurers become more familiar with the theme of circular procurement. One of the interviewees mentions that when the roadmap circular land tendering was written in 2017, it was still too early to require material passports from tenderers, where in 2020 this was required in one of the case studies and incorporated in all tender proposals (personal communication, May 22, 2020; personal communication, March 19, 2020). This illustrates how the market is moving, and how tender criteria should adapt constantly to the market conditions.

Almost all experts mention that the tender criteria should define the procurer's ambition regarding circularity, and it should be left to the tenderer how they furnish proof they obey to the criteria. Any discussion regarding the modes of proof can be prevented because it has been provided by the tender. One interviewee mentions that this places the procuring party at the other side of the table, since the procuring party will have to check if the proving mode is sufficient (personal communication, April 21, 2020).

6.1.6 Awarding & control

When the tender is awarded, the responsibility is often shifted to a different team. In this shift, documenting all tender goals and proposals is important to ensure that the new project team understands the agreements (personal communication, May 1, 2020).

The most important aspect in this phase is that the project goals will be reached when the project is realised. A control system must be in place, and agreements with the awarded tenderer are important in this stage. During the previous steps it is therefore important that the goals are well documented, and a control system and contractual binding is accounted in the tender. Many of the interviewees mention that this system is too often lacking, leading to unrealised project ambitions, or uncertainty if the ambitions are realised.

6.1.7 Differences with regular procurement process

The designed tender process was studied and tested against CE goals in a tender. However, it seems likely that the process can also be helpful in tender processes were CE is not an aim, but other qualitative aspects are incorporated. In figure 15, the circular procurement process is compared to a regular procurement process following the EU procurement guidelines.

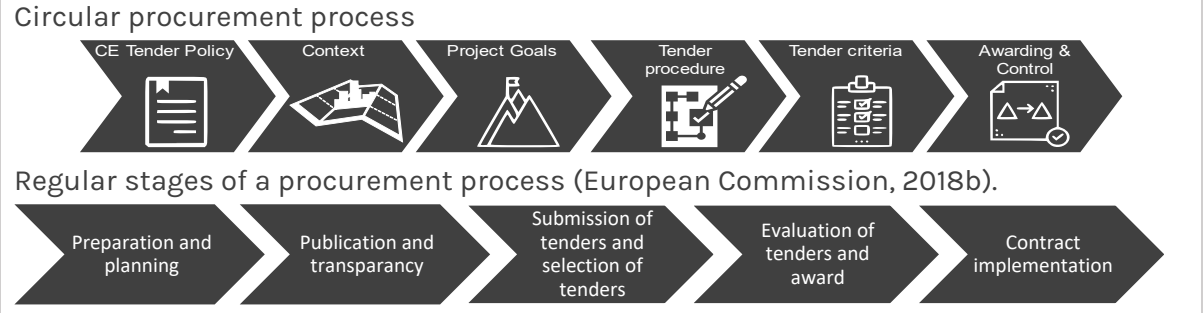


Figure 15: Circular and regular procurement process

Although the steps in both procurement processes in figure 15 are titled differently, most of the contents are similar. Especially towards the end, tenderers are selected, awarded and the contract must be implemented. In the preparation phase, the circular procurement process is more detailed. Table 12 shows the contents of a circular process, compared to the contents of these steps in a normal process.

Table 12: Difference circular tender process and regular tender process

Steps	Circular tender process	Regular tender process
CE tender Policy	• Availability of policy on CE land tendering • Implementation of policy	• No CE policy on land tendering applicable
Context	• Conducting context study towards CE objectives	• No context study, or not to CE objectives
Project Goals	• Formulation of CE goals • Balancing CE goals with other quality goals	• No CE goals
Tender procedure	• Tender procedure to stimulate CE and innovation (e.g. with a dialogue)	• Tender procedure which support tender goals
Tender criteria	• CE criteria are still in development. Research towards criteria which measure the goals and are feasible for tenderers may be necessary	• Formulate criteria
Awarding & control	• CE control systems are still in development. In many tenders, processes control systems are put in place together with the tenderer	• Check criteria

Two main differences can be retrieved from this table: the first (preparational) steps in a circular tender process need more attention than in a normal tender process, and the last steps may need more research. The extra preparation is necessary because CE aspects need to be well defined. By following this more extensive process of preparation, the CE goals can be clearly defined. The extra research in the final steps of a tender process is necessary because the measurement of CE aspects is still developing. Together with the tenderer the best control system must be researched. In more developed quality subjects, these control systems may already be widely available.

Overall, it is positive that the CE process deviates little from a normal tender process as this makes the implementation of CE in tenders easier. However, procurers must be aware of the differences of both processes.

6.2 Circular material tender criteria

This chapter describes how the goal of circular materials can be translated into a tender criterion. Figure 13 illustrates the purpose, where a goal is defined to stimulate circular materials in the tender proposals. This means the minimisation of virgin material use, and the stimulation of the re-use of materials and elements. The aim of this chapter is to find tender criteria which measures this goal and can be used to assess proposals.

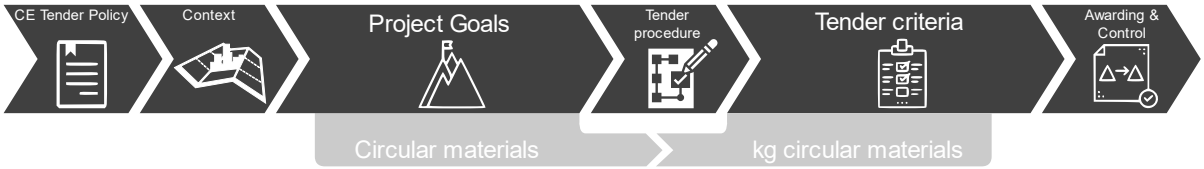


Figure 16: Translation of circular materials goal into tender criteria

6.2.1 Currently used criteria

In the four studied cases, circularity was measured with BREEAM criteria or an MPG score. Both are used because they define a score and allow flexibility during the development process to make changes. Several experts mention that a downside from using BREEAM in a tender is that it is a prescriptive checklist. Tenderers have an incentive to take the measures which score on the checklist, but this does not automatically lead to a more sustainable or circular building (personal communication, May 21, 2020; personal communication, May 23, 2020; personal communication, May 28, 2020). A score which does not prescribe specific measures would be better. The MPG score meets this requirement because it calculates the environmental footprint of the material to a score: the lower the score the more environmental-friendly the material.

However, there are several drawbacks on the MPG. It is not suitable, per se to request in a tender phase: it blocks innovation and it is not designed specific for circular materials. This starts with the suitability to request the MPG as a tender criterion. To calculate the MPG score, a bill of materials is required together with information of the supplier to know the environmental footprint of every material. This is possible if a building is requested, including detailed drawings, but not when tenderers must make their own design (personal communication, May 21, 2020; personal communication May 24, 2020). There is a belief that an MPG cannot be requested in a tender at all (personal communication, May 28, 2020). However, most experts say that an MPG can be requested as an assumed MPG. In this case, it is questionable if this MPG score can be maintained in the contract and enforced as a hard requirement. The second criticism is that the MPG blocks innovation (personal communication, May 21, 2020). Information of materials is retrieved from the National Materials Database (NMD) only materials which have undergone extensive testing are allowed in this database. For innovative materials, alternative calculation methods are possible. However, the usage of these materials is not sufficiently stimulated in the MPG. Finally, there is also criticism on the MPG that it is not designed for circular material use (personal communication, May 21, 2020; Backes et al., 2018). In a discussion on how circularity can be incorporated in tenders, it was suggested that the R-ladder should therefore be added to an MPG score (Schootstra, 2020).

Based on the previously mentioned criticism and motivations, a new circular building material criterion should apply to these conditions:

- Effective: A result is scored based on the effect, without prescribing any measures.
- Enforceable: A score should be made which can be adopted in the contract and enforced during the development.
- Flexible: Making it possible for the tenderer to further develop the building after the tender.
- Innovative: Making it possible to use innovative materials, which have not gone through extensive testing yet.
- Proportionate: It must be feasible for tenderers to work out the criterion in the tender phase without making too many assumptions or costs.

6.2.2 Proposal circular material input criterion

The starting point for designing a circular material criterion was to think of a criterion which uses the R-ladder to assess circularity. Additionally, the criterion must meet to the conditions mentioned in the previous paragraph. This led to the proposed criterion in table 12. The criterion calculates a score based on the materials used in the tender proposal, where different steps in the R-ladder are awarded differently. The criterion can be used by a procuring party to demand tenderers to calculate a score in tender proposals. These quantitative scores can be compared to assess objectively which proposal has the highest score on circular materials.

Table 13: Circular materials input criterion

R	Definition	Criterion	*Factor	
R1	Reduce	Amount materials less than reference building (kg)	F1	1,0
R2		Amount of bio-based materials used in building (kg)	F2	0,6
R3	Re-use	Elements / Components reused in building (kg)	F3	0,7
R4	Recycle	Recycled materials reused in building (kg)	F4	0,5
Score = $\frac{(\mathbf{R1} * \mathbf{F1}) + (\mathbf{R2} * \mathbf{F2}) + (\mathbf{R3} * \mathbf{F3}) + (\mathbf{R4} * \mathbf{F4})}{m^2 \text{ BVO}}$				
** Illustrative factors are given, these can vary per tender*				

The circular materials input criterion is tested for two tender proposals in table 13. In this case, both tenderers have a design sketch, with a concept for the construction. Based on these drawings, the tenderer makes assumptions on what type of materials are necessary for the construction and in what quantity. The mass of the materials is put into the table and with the formula, a circular material input score can be calculated. In this case, building 2 has the highest score and will receive the most points for this criterion.

All the interviewed experts said they thought this criterion is workable in a tender. They were positive about the fact that materials are categorised on a rougher scale than in the MPG, aligning better with the choices made by tenderers in the design phase. This leads to more realistic assumptions than the MPG. It is also found beneficial that the criterion clearly defines the aim for more circular material use and the calculation is found transparent.

Experts mention that incorporating the circular materials input criterion in a tender requires more from tenderers than what is currently included in tender proposals. Usually it is not yet known the amount of materials which will be used. One interviewee considers it unsure if tender proposals can identify the type of materials in components, for example the weight of the wood and glass in the window frames (personal communication, May 21, 2020).

Table 14: Circular materials input criterion tested in fictive case.

Building 1			Building 2		
					
	Material	kg		Material	kg
R2	Wood	20	R2	Wood	40
	Bioplastics	0		Bioplastics	5
R3	Reused elements (e.g. doors)	0	R3	Reused elements (e.g. doors)	5
R4	Recycled concrete	5	R4	Recycled concrete	30
	Steel	30		Steel	20
	Concrete	40		Concrete	15
	Plastics	5		Plastics	5
R1	Total	100	R2	Total	120
Input Score building 1: $\frac{(0*1{,}0)+(20*0{,}6)+(0*0{,}7)+(5*0{,}5)}{m^2\ \mathrm{BVO}} = 14{,}5$					
Input Score building 2: $\frac{(-20*1{,}0)+(45*0{,}6)+(5*0{,}7)+(30*0{,}5)}{m^2\ \mathrm{BVO}} = 25{,}5$					

Multiple experts also mention that this criterion does not measure the desired end-result, which is the lowest environmental footprint and exclusion of toxic materials. This can be prevented by some of the implementation actions in paragraph 6.2.4. Overall, it must be regarded as a criterion towards increasing the circularity of buildings. One interviewee states that addressing bio-based and recycled materials by their mass in kg is the right choice, but suggests to calculate the reduction of materials by the environmental footprint and the amount of reused components by linear meter or units (personal communication, May 23, 2020). This is a dilemma. Using different units of measurement will complicate the calculation, but it might also be complicated for the tenderer to calculate the mass of all the components which are reused. This last aspect can be resolved by providing a standard conversion table per element into mass. The expert acknowledges that using mass for all the aspects will work at this moment, but improvements can be made in the future when the environmental footprint is considered (personal communication, May 23, 2020).

6.2.3 Proposal circular material output criterion

Out of the conducted interviews, a dilemma regarding the output criterion arises. Many experts state that the future value of the output materials is more important than the circularity of the input materials. This future value refers to how the materials can be reused when they become obsolete in the building. Establishing this future value is more difficult than establishing the circularity of the input materials. The future value is susceptible to more uncertainty, which makes a criterion for the future value less reliable. Additionally, more information regarding the lifetime of materials is necessary. It is unknown whether tenderers are able to provide this information. This results in a dilemma: it would be good to request the future value in a criterion, but the question is how this can be done in a way that is still workable for tenderers.

A quantitative score to measure if materials can reused when they become obsolete is the Building Circularity Index (BCI). In Dutch this is often referred to as the 'losmaakbaarheidsindex', which literally translates to demountability index. The index is established by consultancy company Alba Concepts and determines if materials can be removed from the building without demolishing any parts by assessing the connections. Several experts state that this kind of assessing would be beneficial in a tender. On the other hand, a process manager of Alba Concepts acknowledges that it is currently not feasible to require tenderers to calculate a BCI score in the tender phase due to the little elaboration on the design in this phase (personal communication, April 28, 2020). An alternative mentioned by another expert is to request tenderers to work out a few critical construction details. The goal of these details is to assess the expertise of the tenderer on circular construction details. Therefore, these can be assessed in a qualitative manner, or according to the BCI (personal communication, April 24, 2020).

This leaves open the question of what can be asked quantitively in a tender request without asking for too much detail from the tenderers. The experts who were interviewed regarded the previously discussed circular materials input criterion suitable to measure the outcome of materials if it is more differentiated. The lifetime of materials is becoming more important since prolonging the lifetime will prevent the use of new materials. A method which is often used to assess the lifetime is the shearing layers model by Brand, discussed in paragraph 3.3. In table 15, all the layers are displayed with their lifetime according to the model by Brand (1994) and are coupled with the most likely strategy to make it more circular. These strategies are based on the lifetime of the layer, as levels with a shorter lifetime are natural more likely to prolong. For layers with a longer lifetime, it is more suitable to make it adaptable, because the future demands are uncertain.

Table 15: Lifetime of a building's layers with most likely strategy

Layer	Life	Solution
Stuff	Day – 1 month	Prolong / detachable
Space plan	3 – 30 years	Prolong / detachable
Services	7 – 15 years	Prolong / detachable
Skin	20 years	Detachable / adaptable
Structure	30 – 300 years	Detachable / adaptable
Site	Eternal	-

There are R-ladder steps that can be taken for the layers, corresponding to the most likely strategies. An example for a tender criterion is given in table 15, where a score is calculated for the output of circular materials. Like the materials input criterion, the output criterion is split up in the different R-steps. The step of refusing materials is added with the step of repairing. This combined step refers to prolonging the lifetime of materials, under which criteria for the space plan and services are defined. The R-step to re-use materials refers to detachable materials and can be taken for every layer. Finally, there is an R-step for recycling, where materials are processed and become part of new materials. The layer of stuff is omitted, because defining what will be the stuff in the building is found to be too premature in the tender phase.

The circular output criterion in table 15 does not mention any units of measurement. For all the layers, a percentage of the total must be calculated. This is the percentage which is designed according to the specific R-step. A unit of measurement must be defined for each criterion, which does not have to be mass, in contradiction to the circular material input criterion. Since each criterion is calculated based on a percentage of the total of the layer, the most fitting unit of measurement can vary per step. For example, the number of doors will probably be calculated based on units and the measuring unit for walls is linear meter.

Table 16: Circular materials output criterion

R	Definition	Criterion	*Factor	
R5	Refuse / Repair	The % of space plan (e.g. inner walls, building finishing's, doors, etc.) which is designed for a longer lifetime	F5	0,7
R6		The % of services (e.g. HVAC, elevators, plumbing etc.) which is designed for a longer lifetime	F6	0,7
R7	Re-use	The % of space plan which is detachable and can be reused again	F7	0,5
R8		The % of services which is detachable and can be reused again	F8	0,5
R9		The % of skin (e.g. façade) which is detachable and can be reused again	F9	0,5
R10		The % of structure (load bearing elements) which is detachable and can be reused again	F10	0,5
R11	Recycle	Amount of materials (% of total) which can be recycled into new materials	F11	0,1

$$\text{Score} = \frac{(\text{R5} * \text{F5}) + (\text{R6} * \text{F6}) + (\text{R7} * \text{F7}) + (R8 * F8) + (\text{R9} * \text{F9}) + (R10 * F10) + (\text{R11} * \text{F11})}{m^2 \text{ BVO}}$$

** Illustrative factors are given, these can vary per tender*

There is currently little experience with a criterion measuring the circular output value of materials. The criterion in table 15 is a step further into quantitively assessing this value. However, qualitative substantiation is still necessary to underpin why tenderers think their proposals reach a certain score. Due to more uncertainty in the future and less experience with a output criterion, it is advisable to start with a qualitative assessment using a quantitative score based on the criteria in table 15. This can be used to give a clear focus point as procuring party and to assess all tenderers based on a proposal in a similar framework.

6.2.4 Implementing the criteria

When the circularity criteria are implemented, this will affect other parts of the tendering process. The start of paragraph 6.2 stated that circular materials must be defined as one of the project goals. Figure 17 shows the effect on the other steps in the tender process. In the preparation phase, some extra effort may be required to request circular materials. Finally, in the awarding and control phase, the criterion score can be implemented in the contract, to make enforcement possible.

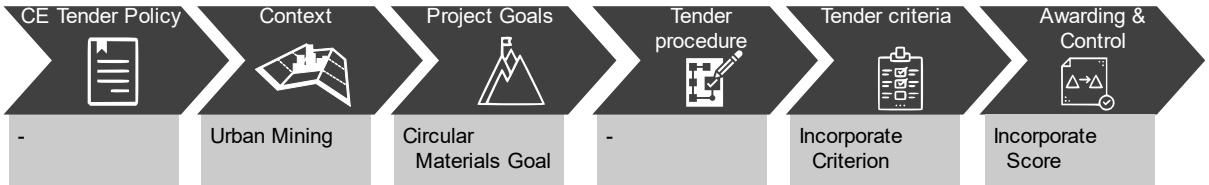


Figure 17: Effect of circular material criteria on tender process

The criteria which are shown in table 12 and table 15 can be used as framework criteria in a tender to measure the value of circular materials. Before they are implemented, a few things need to be decided:

- Determining the R-steps, factors & Reference building.
- Determining conditions (e.g. excluding toxic materials, requiring certificates & maximizing range of origin (secondary) materials) and other criteria such as the MPG.
- Determining a conversion table for elements & components.

The proposed criteria offer a guideline on how the R-ladder can be introduced as awarding criteria in a tender. A procurer can choose to leave out some of the steps or add extra steps. One expert for example mentioned that bio-based and secondary materials could be merged into non-virgin materials, preventing that materials can be classified as secondary and bio-based materials (personal communication, April 28, 2020). Another expert expressed the wish to keep these criteria separate. When there is already a building on site, reusing materials from that building could be awarded higher (personal communication, April 23, 2020). In any case, a requirement should be added that materials can only be categorised in one of the R-steps. After defining the R-steps, the factors must be defined. Example factors are given in table 12 & table 15, but these can and should be adapted per tender (personal communication, April 21, 2020; personal communication, April 23, 2020). With determining these factors, it is important that F1, the factor for reducing materials, is the highest factor to prevent that putting unnecessary materials in a building is rewarded.

Secondly, conditions must be defined regarding the criteria. The experts mentioned several risks that must be prevented by defining these side conditions. These risks are listed in table 17, together with a possible prevention or solution to overcome the risk.

Table 17: Risks and solutions for implementing material criteria

Risk	Prevention / solution
• The (re)use of toxic materials	• Applying lists of restricted materials, such as list of toxic materials by RIVM.
• The use of unwanted chemically treated bio-based materials	• Use clear definition, for example by CEN (2014)
• The use of uncertified bio-based materials, leading to deforestation	• Require of certifications, such as FSC certificate
• Import of (secondary) materials from far away, leading to high transport emissions	• Define maximum radius of origin, e.g. based on 'Regional materials' criterion by LEED certificate (USGBC, 2009)
• Materials with a high environmental impact are not excluded	• Requiring a maximum MPG score to score on circular materials.

For the R-step of reused elements, a conversion between the number (or linear length) of certain elements will make it easier for tenderers to calculate a score. When a standard conversion table is provided by the requesting party, which is obligatory to use, opportunistic assumptions by tenderers regarding the weight of elements will be prevented. The website of the NBD (Nederlands Bouwdocumentatie, Dutch construction documentation) provides standard weights of construction elements, which could be used for a conversion table. An example of a conversion table based on these standard weight is shown in table 16, where a range of weights was given, the average weight is chosen.

Table 18: Conversion table for reused elements

Element	kg	Source
Indoor wall elements	30 kg / m	NBD (n.d. -a)
Door	25 kg / door	NBD (n.d. -b)
Ceiling elements	6 kg / m^2	NBD (n.d. -c)

6.3 Circular adaptivity tender criteria

This chapter describes how the goal of adaptive building can be translated into a tender criterion. Figure 18 illustrates the purpose, where a goal is defined to stimulate circular materials in the tender proposals. With adaptive building is meant: the capacity of a building to accommodate a changing functional demand. The aim of this chapter is to find tender criteria which measure this goal and can be used to assess proposals.

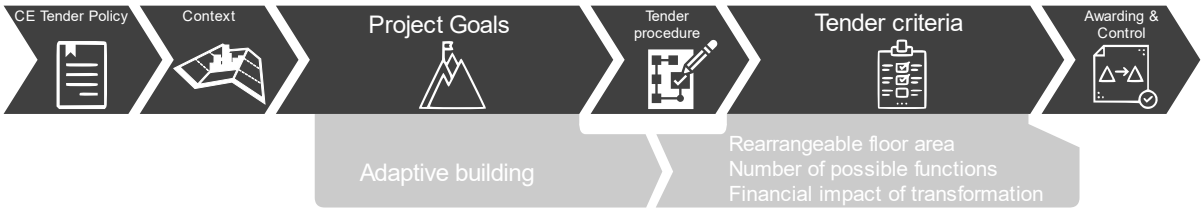


Figure 18: Translation of adaptive building goal into tender criteria

A building can be adaptive in two ways. Firstly, adapting while maintaining the same function (e.g. an office floor which is adaptable to various lay-outs or a house which suits different lifestyles). Secondly, a building can be adaptable by transforming it to a different function (e.g. an office which is transformed into housing).

In general, experts say that the goal of adaptivity is more important than the goal of circular materials. It is seen as a step higher on the R-ladder because it prevents the construction of a new building when demands change (personal communication, April 21, 2020; personal communication, April 22, 2020; personal communication, April 23, 2020). However, there is also a counter belief that circularity is merely about reusing the materials, and adaptivity is not necessarily an aspect of circularity (personal communication, April 24, 2020).

In the case studies of Delftseplein and HUQ, the adaptivity of the building is mentioned as an aim. In both pf these cases, the municipality wanted to prevent the abandonment of buildings they saw during the last economic crisis (personal communication, March 6, 2020; personal communication, March 19, 2020). In both cases, tender proposals were assessed based on the extent to which they are future proof, using a qualitative assessment on function changes (Gemeente Rotterdam, 2019a; Gemeente Utrecht, 2016a). A quantitative tender criterion is not known, although a quantitative criterion is preferred by most experts (personal communication, April 22, 2020; personal communication, April 23, 2020; personal communication, April 28, 2020).

6.3.1 Currently used measurement techniques

There are two known tools which are used to measure the adaptivity of a building: Flex 4.0 by TU Delft researcher Geraedts (2016) and a tool by BREEAM (2018), which is used for their certification. Flex 4.0 defines 12 general adaptivity indicators. These are supported by 16 indicators which are only applicable in specific cases. The 12 general indicators are shown in Table 17. Many of these criteria deal with creating a surplus, for example in floor space, floor height or installation capacity. However, the goal of creating a surplus is conflicting with the R-ladder, which states that the use of materials must be minimised. Experts see this conflict but mention that creating a surplus during construction can minimise material use in the long term (personal communication, April 21, 2020; personal communication, April 23, 2020).

Table 19: Flexibility criteria (based on Geraedts, 2016).

Flexibility performance	Scoring criterion
Expandable site / location	The more surplus space, the more expansion possibilities
Surplus of building space / floor	The more the building is oversized, the more possibilities for rearrangements
Surplus of free floor height	The more floor height, the more possibilities for transformations
Access to building	The more decentralised access points, the easier to be used by different groups
Positioning obstacles / columns	The less obstructing parts, the easier to be transformed / rearranged
Façade windows to be opened	The more windows to be opened, the easier to be transformed / rearranged
Daylight facilities	The higher the daylight factor, the easier to be transformed / rearranged
Customisability / controllability	The more facilities are customisable, the easier to be transformed / rearranged
surplus of facilities & shafts	The more surplus of facilities, the easier to be transformed / rearranged
Modularity of facilities	The more facilities are modular, based on the grid size, the easier to be transformed
Distinction between support – infill	The more construction components belong to infill, the easier to be transformed / rearranged
Horizontal access to building	The more the units are horizontal accessible by a core, the easier to be transformed / rearranged

Another method to calculate a building's adaptivity is a tool by BREEAM (2018). The criteria used by BREEAM are listed in table 20. Compared to the method by Geraedts, the BREEAM criteria are more focused on modular building, which is less conflicting with the R-ladder and would be easier to combine with other CE goals.

Table 20: Flexibility criteria (based on BREEAM, 2018).

Flexibility performance	Scoring criterion
Placement of columns	The bigger the grid size, the better
Replaceable inner walls	Walls which are replaceable, demountable & rebuildable
Enough electricity connection points	The more places electricity connections are possible, the better
Possibility to regulate facilities per grid size	Electricity & water installations can be regulated per grid size
Replaceable inner walls (separating functions, e.g. office & housing)	Walls which are replaceable, demountable & rebuildable
Position of entrance and core	Building with >2 wings and decentral & central entrances & cores
Bearing façades	No bearing façade
Possibility to separate building in smaller units	The smaller, the better
Presence of entrance, core, pantry & sanitation per unit	The more facilities present, the better
Bearing capacity of floors	The higher, the better (> 5 kN/m^2)
Floor space within 7 meters from facade	The more, the better
Floor to ceiling height	The higher the better (< 3,5 m)
Placement of facilities	Accessibilitiy of facilities (electricity & water)

The two adaptivity measurement tools both assess buildings on how they are transformable or rearrangeable based on their constructional layout. The first tool by Gereadts (2016) has a focus towards creating an excess of building volume and separately

functioning compartments. The second tool by BREEAM (2018) focuses on the assessment of constructional elements, which can obstruct any transformation. Both focus points relate highly to the constructional elements of a building, which have mostly been designed in the tender phase. It should therefore be possible to assess the adaptivity in the tender phase based on these kinds of criteria (personal communication, April 21, 2020; personal communication, April 22, 2020; personal communication, April 23, 2020; personal communication, May 1, 2020).

Even though both measurement tools use criteria which can be requested in a tender, there are remarks for the implementation of the tools as tender criteria. Firstly, the case studies showed that project developers prefer tender criteria which specifically describe the municipal goals. This must also be applied for the adaptivity criterion, which must give directions on transformation (personal communication, April 23, 2020). These directions must include the adaptivity conditions, for example regarding ventilation, building layout, and incidence of light (April 28, 2020). This must be accompanied with very clear definitions (personal communication, April 21, 2020). However, it is difficult to say if a criterion for adaptivity will lead to very different proposals because experience with adaptivity tender criteria is limited (personal communication, April 23, 2020).

6.3.2 Tender criteria for an adaptive building

The previous paragraph showed that the criteria from Flex 4.0 and BREEAM are suitable to be incorporated in a tender criterion for adaptivity. In addition, remarks were given on the incorporation of adaptive tender criteria. Based on these remarks and the current adaptivity measurement techniques, a set of requirements can be formulated for requesting adaptivity in a tender:

- Adaptive area: Specify which initial functions must be made adaptive for transformation.
- Measures: The criterion must visualise which measures are taken by the tenderers (such as increased floor-to-ceiling height or demountable walls).
- Scenario's: Specify possible future functions but give flexibility to tenderer.

Three different criteria have been defined to assess the adaptivity of tender proposals. These criteria are presented to the experts in the interviews and they were asked to reflect on the criteria in table 21. In this table, the first two criteria assess the technical aspects of a building. The financial aspects of a transformation are also incorporated in the last criterion.

Table 21: Possible adaptivity tender criteria

Criterion	(Possible) units of measurement	Score calculation
Rearrangeable floor area	• Free floor area without load bearing walls • Grid size • Floor height • Daylight factor • Installation capacity	• 0 – 100 % • Floor area, based on Flex 4.0 or BREEAM
Number possible of functions	• Number of feasible floorplans • Installation capacity for different functions	• 0 – n functions • Predefined functions, or defined by tenderer
Number of feasible business cases	• Transformation costs • Revenues of new functions	• 0 – n business cases • Most feasible business cases

For the criterion to assess adaptivity based on the percentage of rearrangeable floor area, the criteria by Flex 4.0 and BREEAM can be used. This requires the municipality to define how adaptivity is scored, which can be done in two ways:

- Applying the scoring systems of Flex 4.0 or BREEAM, where a score is calculated for the entire building. This score is then used for assessment in the tender.
- Define a minimum level of adaptivity based on Flex 4.0 and BREEAM (such as minimum grid length of columns, minimum daylight entry level, and minimum installation flexibility), and award based on the percentage of floor space which meets these requirements.

The interviews did not go into depth on which of these two ways is the most fitting to request adaptivity in a tender. Therefore, nothing can be said on what the best method of requesting adaptive criteria is. In addition, different tenders will require different methods of measurement (personal communication, April 24, 2020). Therefore, the municipality must pre-define what functions or floor areas must be adaptive, and what extent of adaptivity is required.

The second criterion focuses on the number of functions that the building can accommodate. In this criterion, the tenderer must make it plausible that the building can easily be transformed into several different functions. This can be done by delivering a set of floorplans, together with a solution to other constraining criteria, such as the daylight factor and ventilation capacity. The main hurdle for implementing this criterion is seen in defining the different functions. Therefore, it is advisable to predefine a list of desired future functions, together with their requirements (personal communication, April 21, 2020; personal communication, April 28, 2020). The municipality would predefine, for example, that an office must be transformable in either housing, commercial area, or educational facilities. Thus, the information which must be given by tenderers, such as floorplans and a concept for flexible HVAC installations, can be required.

The first two criteria in table 19 were generally perceived as feasible to request in a tender. The criteria are based on information which is available in the tender phase. However, it is difficult to say if the criteria will lead to buildings that will be used for a longer timespan with a more intensive use (personal communication, April 23, 2020). Experience by similar criteria is limited, therefore it is advisable to start with creating more experience with requesting adaptivity in a quantitative matter. This can be done by assessing the quantitative numbers in a qualitative manner or giving little weight to the adaptivity criterion. The added value of having an adaptive building criterion is mainly seen in forcing real estate developers to think about adaptivity (personal communication, April 21, 2020). Like the criteria for circular materials, adaptive building criteria will affect the tender process. These effects are shown in figure 19, where the effects of an adaptive criterion on the rest of the process steps in illustrated. These effects are illustrative and can vary a bit depending on the chosen adaptivity. From figure 19 there is also an effect visible which moves backwards in the process. When a goal is formulated for adaptive building, it must be ensured that a flexible land-use-plan is in place. If this is not the case, adaptations must be made.

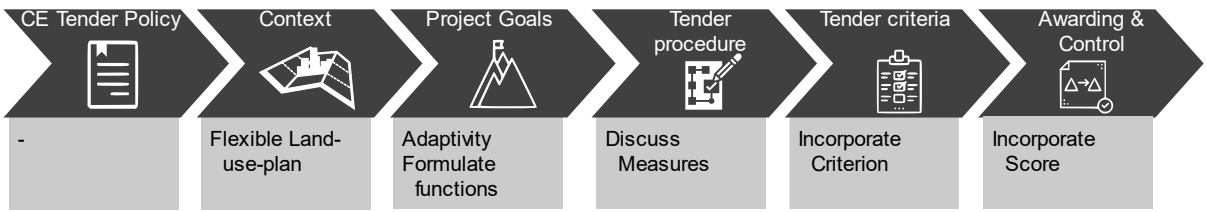


Figure 19: Effect of adaptive building criteria on tender process

Experts were enthusiastic about the last criterion in table 19 because it incorporates the technical and financial aspects of adaptivity. However, none of the experts had experience with a similar criterion and it is therefore not possible to conclude if it is feasible to request multiple business cases in a tender (personal communication, April 21, 2020; personal communication, April 23, 2020; personal communication, April 24, 2020). An exploration of integrating the financial and technical aspects of adaptation is done in the next paragraph.

6.3.3 Prospect to adaptive request: financial impact criterion

The last adaptivity criterion which was presented to the experts in the interviews is a criterion where the financial and technical aspects of adaptivity are combined. The combination of financial and technical aspects in a tender was mainly regarded positively, but they had not worked with similar criteria yet (personal communication, April 21, 2020; personal communication, April 23, 2020). This paragraph explores how the financial impact of adaptivity can be assessed with a tender criterion.

The goal of a financial criterion for adaptivity is to show the financial impact of transformation interventions. It focuses on the adaptive aspects of the building, disregarding the organisation aspects of adaptivity. In many cases, a function change will be linked with an organisational change. In these cases, the transformation costs will be paid by a new owner, but the lower transformation costs will reflect a higher residual value for the initial owner. Consequently, the financial aspects of a building's transformation are defined as:

- The initial investment costs (during construction of the building)
- Initial rent revenues
- Operating costs
- The drop in rent revenues of the existing function
- The increase in new rent revenues of the new function
- The construction costs of the transformation

These six cashflows are visualised in figure 20. By visualizing these six cashflows, the aim is to show the financial potential of adaptivity. This can be that a small extra initial investment can make future transformation easier, resulting in a higher use-potential or a higher residual value.

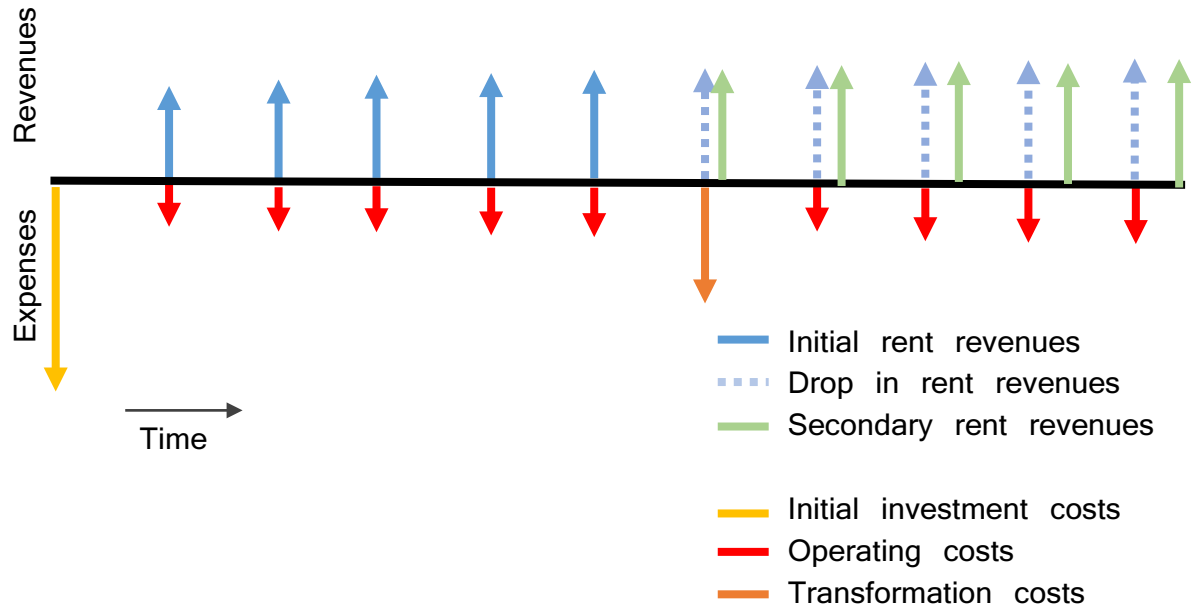


Figure 20: Financial cashflows adaptivity

Apart from the goal of visualizing cashflows, there are also some considerations. The first is that prices will fluctuate over time (personal communication, April 21, 2020). Therefore, it is almost impossible to make realistic assumptions on what the transformation costs will be. When the procuring party pre-defines the price increase that must be used by tenderers, all proposals can be assessed based on the same information. To create uniform price assumptions, it is also necessary to predefine a transformation moment. This moment is a fictional moment when the transformation will take place, so all tenderers will calculate with the same cashflows. Secondly, the procuring party must give a direction on desired functions for transformation (personal communication, April 28, 2020). This can be done by providing a list of desired functions, where the tenderer can choose which functions to incorporate in the financial calculations.

The goals for visualisation and requirements for fixed agreements are listed in table 20. By predefining price fluctuations, the final applicability of the financial calculations may not be realistic. After all, at the moment of tendering one does not know when the building will be transformed, what the price changes will be, and what the desired functions will be in the future. The goal of this criterion must therefore be to stimulate tenderers to think about the financial feasibility of the adaptivity in their proposal, not to create a ready-made business case which can be used at the moment of transformation.

Table 22: Goals and predefined uniformities financial adaptivity criterion

Visualisation goals	Predefined fixed uniformities
Initial investment costs	Price fluctuations
Initial rent revenues	Moment of transformation
Operating costs	Vacancy rate
Drop in rent revenues	Desired functions
Secondary rent revenues	
Transformation costs	

Together with consultancy company Fakton, these goals and requirements have been translated into a criterion that can represent the financial aspects of adaptivity. This criterion is based on a regular financial criterion, which is often requested in land tendering. Table 21 shows all the financial aspects that must be filled in for the criterion.

Table 23: Financial impact adaptivity tender criterion

Fixed: requirements				
Start construction	M - YYYY		Functions to be transformed:	e.g. offices, commercial area, …
Start transformation	M - YYYY			
Inflation Construction	X %			
rent	X %		Possible future functions:	e.g. housing, educational, …
Vacancy rate (VR)	X %			
Initial Floor area calculation				
		GFA		
Function 1		m²		
…		m²		
Total initial GFA		m²		
Development & construction costs				
Initial construction costs	Function 1	€ -		
	…	€ -		
Additional costs (as % of construction costs)		€ -		
Total construction costs		€ -		
Initial Revenues				
			Value	
Function 1	Rent	€ -	€ 0,00	
Function …	Sale	€ -		
Total value		€ -		
Initial financial result				
Total value – total construction costs				€ -
Drop in rent revenues				
		Rent (adjusted with inflation)		
Function 1		€ -	X VR %	
…		€ -	X VR %	
Total drop in rent revenues			€ -	
Secondary floor area calculation				
		GFA		
Function 1		m²		
…		m²		
Total GFA transformed		m²		(= VR% * total initial GFA)
Transformation costs				
Transformation costs	Function 1	€ -		
	…	€ -		
Additional costs (as % of transformation costs)		€ -		
Total transformation costs		€ -		
Secondary Revenues				
			Value	
Function 1	Rent	€ -	€ 0,00	
Function …	Sale	€ -		
Total value (secondary)		€ -		
Secondary financial result				
Total value (secondary) – total transformation costs				€ -

For the criterion of table 21, the municipality will prescribe some requirements which are uniform over all tenderers. Subsequently each tenderer must fill in the rest of the table regarding their proposal. The initial floor area calculation, development & construction costs, and initial revenues are normally already requested in a tender. Based on these aspects, a financial result is calculated which will result in a financial bid for the land.

The second part of table 21 calculates the financial impact of a transformation. It will first visualise the drop in rent revenues, based on the predefined vacancy rate and the previously (by the tenderer) entered rent levels. From this point the transformation is calculated. Like the initial calculations, a financial result is calculated based on the transformation costs and new rent revenues.

The criterion in table 21 is made for the purpose of this graduation thesis. It aims to give an indication how the financial aspects of adaptivity can be integrated in a tender criterion. However, it is not ready for application in a tender to assess tenderers. Before it can be applied the following hurdles must be overcome:

- It must be elaborated.
  For the purpose of showing the financial impact of adaptivity, the criterion has been simplified. More aspects will have to be included to apply it in a tender (such as construction time, yield calculations & discount rate).
- The feasibility for tenderers must be studied.
  There is too little information on the impact of this criterion on real estate developers. One real estate developer stated they always develop multiple business cases for a building and requesting financial aspects of adaptivity is feasible (personal communication, April 22, 2020). This study must be conducted with more real estate developers.
- The assessment method must be defined.
  The financial criterion will result in a quantitative number regarding the transformation. However, the plan with the highest financial result is not necessarily the best plan. Plans must be assessed on the likelihood of transformation possibilities, which is a qualitative assessment of the financial aspects.
- The criterion must be further developed.
  The interviewed experts stated they do not have any experience with similar criteria. Experience with the criterion is necessary to understand the impact of the criterion. Using this experience, the criterion can be developed further.
- Define additional required documents.
  The technical aspects are an important aspect to substantiate the financial assumptions. The changes that are necessary for the transformation must be available to estimate the transformation costs. For substantiation, the municipality can request, among others, floorplans, construction details, and materialisation of walls.

Overall, the main aim of the financial impact criterion is to represent the financial impact of transformation. It does not provide a blueprint for a possible transformation process. The criterion helps to get uniform tender proposals, which can be compared based on how they handle the transformation.

6.4 Conclusions

The aim of the second part of the empirical research is to study how future tenders can be improved by presenting improvements to several experts. This part answers the last two sub-questions:

7. How can tender processes be improved to foster circularity in land tendering?
8. How can circularity be requested in a land tender?

6.4.1 How can tender processes be improved to foster circularity in land tendering?

To improve circular land tendering, a process proposal was made which is discussed in paragraph 6.1. Important findings from this process proposal are that anchoring of circularity is important throughout the tendering process, from policy formulation up to checking if the goals have been realised in the construction and operation phase. In the studied cases, it was often seen that the whole process is not yet in place. Circular actions are made but these do not get a follow-up in the next process step.

Municipalities must clearly define the goals they try to pursue with a tender, so these can be translated in tender criteria. Only then, real estate developers know to which goals they must find an answer in their proposal. For a successful implementation, around four main goals can be incorporated in the tender, which are translated into tender criteria. These goals must derive from policy and the context, to ensure the building will contribute to the policy goals and adapt to challenges from the context.

The tender goals must be translated into tender criteria, because these have the biggest influence on tender proposals. Tender criteria must be enforceable in the contract phase and give enough flexibility to the market to further develop the building plans and come with creative solutions. Quantitative scores which measure the municipal goal without prescribing any methods, such as the MPG and EPC score, seem to be best fitting to these requirements. However, a difficulty with these scores is that they require a lot of information, which is mostly not available in land tendering. When the industry becomes more familiar with these scores, and the scores are further improved, these can be a solution. Up to that time, more simplified methods can offer a solution.

6.4.2 How can circularity be requested in a land tender?

To successfully implement circularity in a tender, criteria that measure the goals without prescribing any methods are necessary. This should result in a score that can be incorporated in the contract to check if the measures are in place. However, the score must be flexible enough to allow changes in the further design phase. Two quantitative methods to measure goals of circular materials and adaptive building were designed and presented to experts.

A circular material criterion which measures the circular value of materials based on the R-ladder can be a good criterion when procurers aim to stimulate circular material use. Less assumptions need to be made compared to other methods, such as the MPG score and it focuses on interventions regarding circular materials. The criterion that has been developed measures the circularity of materials which are used in the building. This criterion almost ready to use in a tender. Experts argue that measuring the future value of materials, how they can be reused when they become obsolete in the building, is more important. Therefore, also a criterion that measures the circular output of materials is also designed. The implementation of such a criterion seems more difficult than a circular input criterion since information regarding the future has more variables and uncertainties.

A second important aim to assess the circular value is the ability of a building to adapt to a changing demand. It is concluded that adaptive criteria can be based on quantitative

measurement tools, such as Flex 4.0 or BREEAM. These tools mainly assess constructional elements. This information is largely available in the tender stage. The assessment of adaptive criteria can be done based on a percentage of rearrangeable floor space, or a number of functions to which the building is transformable. In both cases it is important that the municipality pre-defines the restrictions. For example, the possible functions and free floor space.

Finally, a perspective for improvement is given on how financial aspects of adaptivity could be integrated in a tender criterion. Experts were enthusiastic about this, but for implementation further research is necessary.

Conclusion, discussion & recommendations

7 Conclusion

The aim of this graduation research is to improve circular land tendering. This is done by giving an insight in municipal circular land tendering goals, with a link towards how real estate developers respond to these goals. Using a literature study, case study research and expert interviews, the sub-questions are answered one-by-one in sub-conclusions. This is done to find the answer to the main research question:

''How can tender requests be improved to pursue municipal circular building goals in land tendering?''

7.1 Theoretical framework

The theoretical framework consists of two parts: firstly, the circular economy is discussed, and secondly the theme of land tendering. In the different chapters of the theoretical framework the following sub-questions are answered:

1. What is a circular economy?
2. What is land tendering?
3. How can the circular economy aspects be integrated in a land tender?

7.1.1 Circular Economy

The first part of the theoretical framework describes several definitions and models of a CE. A uniform definition of a CE was not found. Most definitions include the concepts of 'reuse' and 'recycle', referring to the looping of materials. In most cases, these concepts rest on two perspectives: the environmental and economic perspective. The environmental perspective is based on the fact that the production of the materials we use, is the source of 45% of CO2 emissions. The goal is to minimise the environmental harm by minimising the virgin material consumption. The economic perspective of a CE is concerned with the implementation of CE, referring to new business models and economic activities. New business models are required to stimulate sharing and looping of materials and products, which will minimise material consumption.

Different models exist on the implementation of a CE. These models cover various ranges of a CE. This varies from the narrowest view, which takes the looping of materials into account, to wider views that also incorporate social aspects of a CE. These wider models state that a circular economy can only exist if a minimum threshold of social living conditions is reached. For an implementation of CE in the built environment, different conditions apply. The built environment consists of many products with a long lifespan, such as the bearing elements of a building. The long lifespan of these elements makes the adaptive capacity, where it can accommodate different needs, more attractive than reusing the elements when they become obsolete. These different measures are listed in the circular city model by Williams (2019a), who states that there are three core aims for a circular city:

- Looping: Resources in a city must be reused. For example, making new materials from waste.
- Adapting: Buildings must be able to accommodate changing needs. For example, an office which can be transformed into housing.
- Regeneration: Producing energy in a city and regenerating the eco-systems within a city

These three core aims are complemented with four supporting aims. The total of seven aims together represent a city which supports circular activities. Therefore, municipalities should pursue these goals to become circular.

Overall, it can be concluded that there are multiple definitions of a CE. In most cases regarding reusing materials, these will overlap. For the implementation of a CE it is

important to define what a CE is for the case in question, so the goals for a CE can be based on this definition.

7.1.2 Land tendering

Governments have different tools to implement their CE goals. The most low-key tools are related to knowledge development and spread, where the hope is that new knowledge will lead to new solutions. Gaining this knowledge can potentially be done together with market parties or universities. This is often done in the pioneering stages, when the subject (in this case, the definition and implementation of a CE) is not yet fully mature. When governments become more engaged with the subject, mechanisms can be introduced to support the private sector in pursuing the CE goals. Financial mechanisms or other business support can be introduced by subsidisation or taxing schemes, where desired actions are stimulated. Regarding the aim of CE, many reports state that governments should be involved with the development of standards. They can contribute by formulating uniform standards on the definition and implementation.

A different option to pursue circular goals is through procurement mechanisms. Public procurement accounts for 20% of the GDP in the Netherlands. Therefore, governments can have a large influence on the market by the way they procure. This research focuses on their role in land tendering. This is the act where a government sells land to the market, using tender allocation to select a party for the development. Little information on land tendering specifically is found, but concepts of public procurement can be adapted towards land tendering. It is found that it is possible to incorporate circularity as one of the quality aspects in a land tender. When this is done, a tenderer can be (partly) selected based on the circular value of their proposal. Currently, circular procurement is barely used but circular criteria are sometimes used as part of the sustainability goals in a tender.

7.1.3 Circular land tendering

The final part of the theoretical framework discusses how CE goals can be integrated in land tendering. The amount of research on circular land tendering is limited, but some lessons learned from sustainable procurement can be applied towards circular land tendering.

It is found that circularity must be present throughout the tendering process from the moment when policy is formulated up until when the tender is awarded and the execution of project goals must be enforced. CE policy is found necessary to support officials in realising circular goals. At the same time, an organisation must have game changers who are motivated to pursue circular goals in tendering. In addition to policy, a municipality must also formulate CE goals specific for the tender. Next to that, a dialogue with the tenderer and municipality during the tender will help to understand each other in CE definitions and goals. Formulating specific CE goals and holding a market dialogue both help to find a match between municipality and tenderer. This match on CE is important because of the many definitions and goals of a CE. The municipality and tenderer should pursue similar CE goals to realise these during construction.

In the next phase, tenderers must be assessed based on their tender proposal which is done using the assessment criteria. It is important that these criteria do not exclude any parties from the tender, but challenge tenderers to fulfil the circular demands as well as possible. Therefore, circularity must be explicitly assessed. Some CE tender criteria are explored in paragraph 4.5. Since every tender process is different it is difficult to generalise these. In general, two categories of tender criteria can be distinguished: criteria on the technical specifications of circularity and criteria on the process of circularity. Both types of criteria should be made specific and incorporated in the tender. For example, municipalities can request a certain amount of circular materials or request a process how

as much circular materials as possible will be used. Apart from the criteria on circularity, some other criteria may influence the circularity of the proposals. Criteria on price are mentioned as potentially hampering CE development. Therefore, price assessment should be done based on life cycle costs, instead of only assessing the initial investment costs. In addition, when price criteria are incorporated, they should have a weight of at maximum 30%. This will discourage tenderers to keep costs low by cutting investment on circularity.

7.2 Case studies

After the theoretical framework is constructed, the current state of circular land tendering is studied based on a four case studies. In these cases, circularity was incorporated as a goal in the land tendering. The cases are studied on three levels: policy, tender request & tender proposal. The policy level indicates what the overall goals regarding circular building and land tendering are. The tender request indicates the project specific goals and the tender proposal gives insight to what extent these goals have been realised. In these case studies, three sub-questions are answered:

4. How do municipalities currently request circularity in land tenders?
5. How do developers respond to those requests?
6. Where can circular land tendering be improved?

7.2.1 Tender requests

The tender request is the question of a municipality for the market, representing the demand for a building on a plot of land. The case studies consist of four cases of land tendering in three different municipalities. The hypothesis was that circular goals in tender requests derive from policy. However, in two of the three studied municipalities there was no policy available which triggered circular goals in land tendering. In municipalities without policy the circular goals in tenders were devised by officials. In these cases, goals derived from the personal interest of the municipal officials. In one municipality, there was specific CE land tendering policy available. However, this policy did not directly lead to circular goals in the tender. The policy was found to be too extensive and not always applicable and did not include specific guidelines on the implementation. Policy which formulates explicit goals, accompanied by guidelines on how these goals should be implemented in a tender is necessary.

In three of these cases, circularity is part of the goal for a sustainable building. In the other case, circular building is made a specific goal. In the case where circularity is assessed separately, it is given a larger weight in the assessment criteria compared to the other cases. This then has a higher impact on real estate developers who formulate the tender proposals.

The project goals are translated tender criteria to assess tender proposals on their capacity to fulfil the goals. In the case studies, only criteria on the technical aspects of circularity were found. These technical criteria could be divided into roughly two kinds of criteria: quantitative and qualitative criteria. All tenders incorporated qualitative criteria, which are for example the extent of likelihood that ‘the building contributes to a circular economy’, or ‘to minimise the use of virgin materials’. Tenderers were then obliged to substantiate to what extent they fulfil these goals. These qualitative goals were sometimes complemented with quantitative goals, which require tenderers to submit a score. All criteria that are used in the studied cases, are displayed in table 22, together with their strengths and weaknesses, formulated by the interviewees.

Table 24: Circular tender criteria with strengths and weaknesses

Criterion	+	-
Qualitative vision	• Gives freedom to tenderer	• Easy for tenderers to promise a lot, which they do not realise
Qualitative vision with quantification	• Gives freedom to tenderer	• Can be difficult to compare tenderers
MPG score	• Score to measure environmental impact	• Requires a lot information in tender phase • Still in development
BREEAM score	• Widely used certificate in construction	• Prescribes specific measures instead of scoring result

Out of the criteria in table 22, quantitative criteria are advantageous because these scores can be incorporated in the contract. At the same time, specific solutions may be excluded by quantitative criteria because these are not measured. Each project team responsible for the tender request makes its own consideration in how to balance the strengths and weaknesses of these different criteria. Overall, there is a demand for criteria that give freedom to tenderers to come up with creative ideas, but also for guidelines and restraints on the solution space.

7.2.2 Tender proposals

The tender proposal is the response of a tenderer to the tender request from the municipality. In the case where circularity was made a specific project goal, the tenderer participated because of the circular goals. In the other cases, tenderers participated because there was an assessment on quality aspects (broader than circularity), and because they wanted to build on the specific location of the tender.

The tender criteria have the biggest influence on tenderers because the assessment for rewarding the tender is based on these criteria. Therefore, municipalities have the most influence on tenderers with the formulation of their tender criteria. In addition to the criteria, municipalities can influence tenderers by writing a vision on the desired tender outcome. Tenderers often adopt the structure of the tender request in their proposal. In those cases, a stronger position of circularity in the tender request will give a stronger position of circularity in the proposal. The tender request documents are also used by the tenderer to understand what the municipality desires: tenderers want to fulfil these desires the best they can to win the tender. In one case, every municipal tender document was answered with a document in the proposal. Here, the municipal CE vision led to a vision on the CE in the building.

In all four cases, the real estate developers stated that they took actions due to the CE criteria. However, the extent of changes varied per tender. In all cases, consultants were hired to incorporate the circular criteria, but the extent of influence of these consultants depends on the weight of circularity in the tender. In tenders where circularity has a higher weight, the consultants have a larger say in the design.

To have sufficient influence in a tender process, the criteria should weight around 30%. This leads to substantial design changes in the proposal because developers can invest time and money to win the tender. Only two tenders had a weight of 30% or more: both had a construction with a focus on sustainable or circular aspects. In the other tenders, a wider range of ambitions in the tender request was formulated. This leads to building proposals which also formulate this wider range of ambitions but excel less in certain ambitions. Therefore, the number of main ambitions in a tender request should be limited to three or four, corresponding to a criterion weight of 30% per ambition.

7.2.3 Where can circular land tendering be improved?

The aim of the case studies is to explore the current state of circular land tendering, whereby possible problems regarding circular land tendering can be studied and identified. These identified problems will be addressed in the next part, which elaborates on the recommendations.

It was assumed that policy ambitions regarding circular building or circular land tendering would be translated into a tender request, which leads to circular building in a tender proposal. However, it was found that circular building policy or circular tendering policy is not always present, or not sufficient for the formulation of circularity in tender requests. This makes that tender goals are not always formulated to contribute to overall policy goals and the learning capacity from tenders is not fully utilised. Therefore, policy which is more specific and gives guidelines for implementation can foster circular land tendering.

In the absence of circular policy, municipalities formulated tender goals towards circularity. By comparing four cases, it was found that the circular goals were not always specific enough in their formulation. Very specific goals were generally preferred because this gives guidelines for the implementation of the goals in the tender proposal. These guidelines make implementation easier for tenderers. Formulating specific goals can also help to make choices in the tender request. Focussing on a restricted set of goals is important because it was found that sometimes too many goals were defined. This makes it difficult for tenderers to excel in any of the goals, as they have to spread their focus on all the goals.

The translation of goals into criteria is an important step towards the tenderers because proposals are assessed based on these criteria. However, tenderers are quite indifferent about the criteria. They will respond to the tender as long as they think they have a shot at winning the tender with a feasible business case. To achieve this, the procuring party must investigate if the tender goals are perceived feasible by the market.

Lastly, the defined goals and criteria must be enforced to ensure that the goals are also realised. The cases raise some concerns regarding the enforcement because contracts do not always involve the circular goals. Circular aspects should be part of the tender process from the beginning to the end to ensure that the initial goals are realised during construction. Therefore, it is important that the agreed goals are incorporated in the contract. In the studied cases, this was mostly done by adding the tender proposal as an appendix to the contract. In these cases, the tender proposal becomes a framework agreement, defining the rough lines of what must be realised on the plot. To create specific commitment, tender criteria which are quantifiable and verifiable can help. These can be checked during the construction phase.

7.3 Recommendations

The final two sub-questions aim to improve circular land tendering by offering recommendations. The questions which are answered in this part are:

7. How can tender processes be improved to foster circularity in land tendering?
8. How can circularity be requested in a land tender?

These questions are answered by a process design and criteria to request and assess circularity in a land tender.

7.3.1 Process design

It was concluded that a coherent process from policy to construction was not available. In figure 21, a process design is visualised that incorporates all the steps which must be taken in a circular land tender. The contents of each specific process step are elaborately

discussed in paragraph 6.1. The process in figure 21 should be used as a tool to understand the steps of incorporating circularity in a tender. It is important that every step contributes to the entire circular tendering process. For example, the first step of CE tender policy: here the long-term goals must be formulated together with specific guidelines how these goals must be implemented in tender projects.

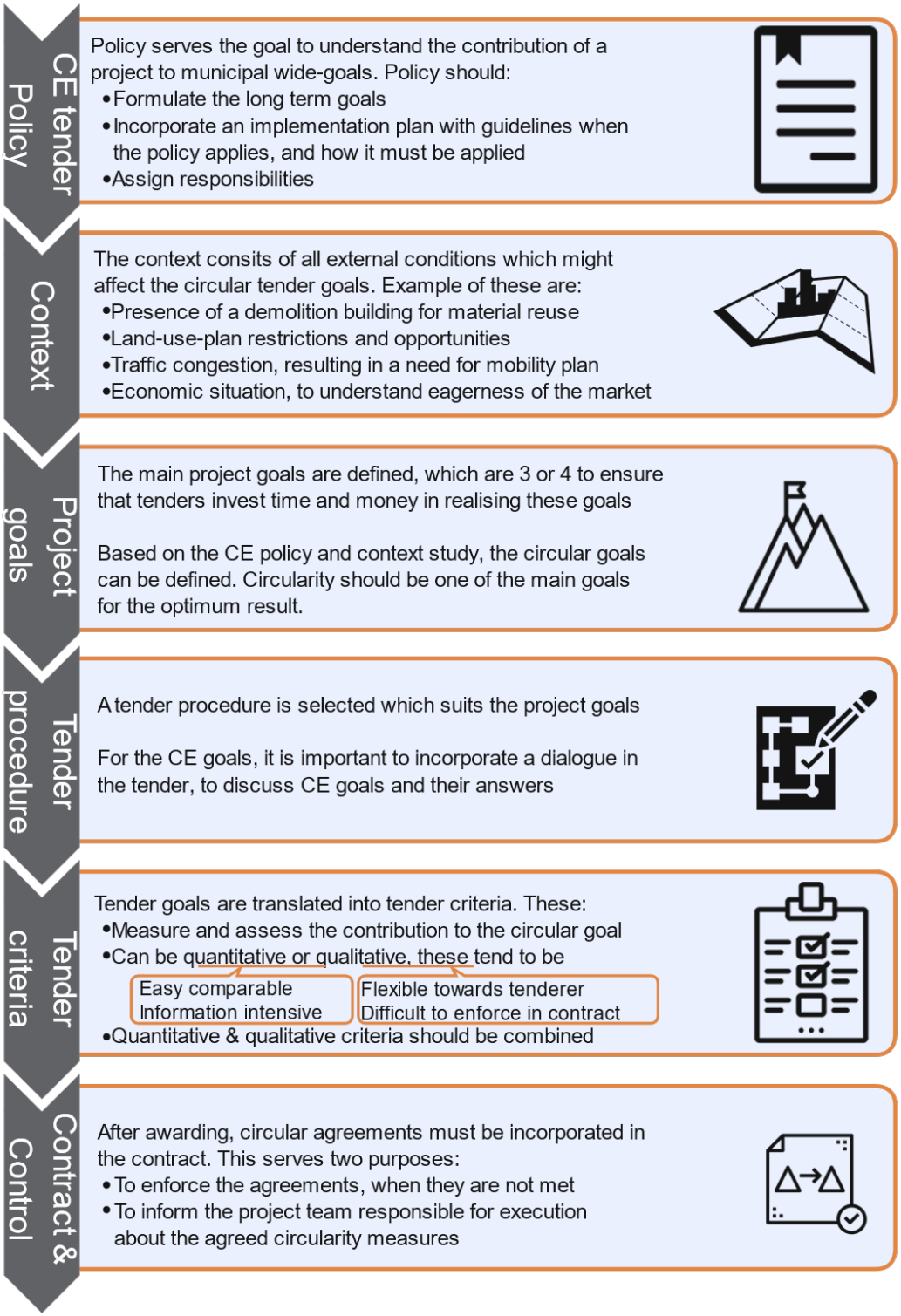


Figure 21: Steps of the circular tender process design

The process design in figure 21 is similar to a tender process where circularity is not included. This is beneficial because it means not an entirely different process is needed to incorporate circularity in land tendering. The circular land tender process focuses more on the preparational steps, compared to regular land tendering processes. This is necessary to properly formulate a CE definition and identify contextual challenges and opportunities, both to formulate CE project goals. A municipality must inform tenderers on the ambitions so tenderers know what they must incorporate in their proposal. Due to the rapid evolvement of CE, project specific goals deserve a lot of attention. The ambition level can probably be increased with every tender. Subsequently, the criteria formulation deserves a lot of attention. Currently, there is still a search going on for the best measurement tools for circularity. Criteria must be formulated which measure the goal for the tender, and that are based on information which is available in the tender phase. When circularity evolves further, it is possible that these criteria will do as well.

Overall, circular land tendering can be improved by incorporating circularity throughout the tendering process, from policy to contracting. In these phases, circularity must be made distinctive. When it is a distinctive goal and criterion, tender entries will specifically address circularity. Additionally, the tender entry must make circularity specific. The more specific the municipality makes their request, the more specific the tender entries will be.

7.3.2 Tender criteria

To study how circularity can be implemented, two tender criteria are designed. Here, the question was asked how a circular goal can be translated into tender criteria. This was done for the circular goal of material looping and the adaptivity of buildings.

For the translation of the goals into criteria, several conditions were found to be important. The criterion must make it possible to compare different proposals on similar aspects. A score, which could be incorporated in the contract, was preferred for this. This score must be flexible enough in the further development, after the tender has been awarded.

Firstly, regarding the goal for looping materials, five conditions were defined which should be reflected into the tender criterion:

- Effective: An output requirement is scored based on the effect, without prescribing any measures.
- Enforceable: A score that can be adopted in the contract and enforced by the municipality during the development.
- Flexible: Making it possible for the tenderer to further develop the building after having been awarded the tender.
- Innovative: Making it possible to use innovative materials, which have not gone through extensive testing yet.
- Proportionate: It must be feasible for tenderers to work out the criterion in the tender phase without making too many assumptions or costs.

This can be achieved in a criterion which scores all the materials which are used in the building. This criterion is elaborately discussed in chapter 6.2. Like the MPG, the criterion calculates a score based on the used materials. However, this score is based on less detailed information, making it a better fit in the tender stage. This score is based the R-ladder, which is often used to define the circular value of materials. A difficulty with the criterion is that it only measures the materials which go into a building, while ensuring that materials can be reused after they become obsolete in the building is found to be more valuable. A prospect is given how the criterion can be used to measure the circular output. However, this will require more information in the tender phase. It is currently difficult to say if this information can be made available during tendering.

Secondly, a tender criterion which can be requested for the goal of adaptive buildings is studied. Regarding this criterion, three conditions were defined which should be reflected into the tender criterion:

- Adaptive area: Specify which initial functions must be made adaptive for transformation
- Measures: The criterion must visualise which measures are taken by the tenderers (such as increased floor-to-ceiling height or demountable walls).
- Scenario's: Specify possible future functions but give flexibility to tenderer.

Three kinds of criteria were designed based on these requirements: the percentage of rearrangeable floor area, the number of possible functions and a visualisation of the financial impact. The first two of these three both map the technical aspects of an adaptive building. This can be measured by already existing methods such as Flex 4.0 or BREEAM. These two methods were found feasible to request and assess the adaptivity of a building, but it was questioned if it would lead to very different building proposals. Lastly, a criterion to visualise the financial impact of adaptivity, and transforming a building, is explored. This has led to an impact table which can be requested in a tender, but more research is required before tenderers can be assessed by this criterion.

7.4 Conclusion

The question "How can tender requests be improved to pursue municipal circular building goals in land tendering?". To stimulate circularity in land tendering, municipalities must set CE tendering policy in place. This helps to anchor circularity in the organisation. During a tender process, circularity must be one of the three or four main quality related goals. This allows tenderers to invest time and money in translating the circular goals in their tender proposal. In most cases, real estate developers will do this by hiring sustainability consultant. The stronger the weight of circularity criteria in a tender, the stronger the say of those consultants in the design.

Finally, criteria were designed which can be used to incorporate the goals of circular materials and adaptive building in a tender. These criteria were based on a quantitative score, so they are enforceable with a contract. At the same time, the score gives flexibility to allow tenderers to make design changes after the tender has been awarded. Some of these criteria are almost ready to be implemented in a tender, some of them give a prospect to the future. This is almost inherent to the CE, which is a rapidly evolving subject.

8 Discussion

8.1.1 Discussion on theoretical framework

In the theoretical framework, the subjects of a circular economy and land tendering are explored. The concept of a CE is still in development. The five most cited papers regarding a CE which were found in the bibliographical research, were all trying to define a CE. One of these papers found 114 different definitions of a CE. Subsequently, multiple models which describe how a CE should function were also found. With all these definitions and models, a CE has become an umbrella term. In most cases, reusing and recycling is meant with a CE. Sometimes other aspects are also included. In these cases, the social or ecological aspects are for example included. The variety in definitions and models makes that the concept of a CE becomes vague. This vagueness does not contribute to the applicability of CE concepts in society. A shared understanding of the CE concept would contribute to the further development of a CE. Since the inclusion of additional aspects can make the definition of a CE vaguer, it is questionable if a holistic view of a CE, where social and ecological aspects are included, contributes to the transition towards a CE. Therefore, clearly defined CE aspects can help to formulate circular goals.

On the topic of land tendering, the amount of literature is very limited. Land tendering is interpreted as a form of public procurement, with the difference that a municipality does not buy something, but sells something in a land tender. It is assumed that the principles of public procurement, also apply on land tendering. There are many similarities between public procurement and land tendering. Both are systems where a government requires something from the market and can incorporate policy goals as selection criteria. There are also some differences, in a land tender the tenderer becomes the owner of the asset and gets responsibility. As a result, the tenderer has already the incentive to take some measures to increase the long-term value. However, in most cases buildings will be sold to investors right after development, and this incentive is lost. In addition, the additional conditions for land tendering may be different than other procurement processes. When a land tender is awarded, construction permits must be granted. Municipalities can be able to require some aspects as part of the construction permit. One example of this was given in the interviews, were it was stated that the architectural quality should be part of the construction permit, instead of the awarding criteria.

8.1.2 Discussion on case studies

Four cases of circular land tendering were selected for case study research. These cases were selected based on the requirements: a completed land tendering cases where circular goals were incorporated. Within the network of the graduation company and TU Delft supervisors, only five cases were found which fulfilled these requirements. The case which was not studied, was also in the municipality of Amsterdam. This shows that mainly larger cities are frontrunners with circular land tendering. However, during the writing of this thesis, new circular land tendering processes have been started, also in smaller municipalities. This shows that, although the big cities are frontrunners, smaller municipalities are also engaged in innovating on the CE.

The cases represent a specific field of land tendering. The four cases are all located in one of the biggest cities in the Netherlands, with a high demand for housing, and on accessible locations. This raises the question if the findings from the cases can be applied on land tendering in smaller cities and communities. Smaller municipalities will generally have less personnel capacity. This means that less specialist knowledge regarding circular construction are present. At the same time, a smaller organisation will create shorter lines between policy an implementation, resulting in a different dynamic between policy and tender. This can make the need for policy smaller, on the other hand can a smaller organisation mean that with personnel changes more knowledge is lost, creating a bigger

demand to capture findings in policy documents. Overall, the main findings from the case study are on a conceptual level, for example with the process which should be followed. These conceptual findings will generally also be applicable on smaller municipalities and communities.

A contrast between the four case studies, in larger cities, and land tendering in smaller municipalities may be found in the demands which can be set. When real estate developers are more eager to build in an area, municipalities can set higher requirements. Developers showed they were motivated to build on prominent locations in the big cities. Additionally, they must achieve a feasible business case for the development. Several interviewees have mentioned that they are not able to set the same requirements as in Amsterdam. Due to the high demand for housing and commercial area in Amsterdam it is easier to get a feasible business case while investing in circularity. On the other hand, one of the interviewees mentioned that the smaller communities are more advanced because there is more urgency to build for changing demands (developer circular economy, personal communication, March 20, 2020).

8.1.3 Discussion on recommendations

The final part of the thesis mentions two sets of recommendations, a circular tender process design and tender criteria. These recommendations are based on the problems which were found in the case study, the discussion on applicability of the cases applies therefore also on the recommendations. The next two sections will elaborate more on the applicability of the recommendations.

The first recommendation is a process design to incorporate circularity in land tendering. Paragraph 6.1.7 already discusses that the differences with a regular land tendering process are little. This is regarded positive, since it means that little changes are necessary to incorporate circularity in land tendering. The differences between a regular process and a circular land tendering process lie mainly in the preparatory phases. Here, defining a CE for the tender deserves attention. The process design shows that this is preferably done based on policy goals and a study of the context. However, the case studies showed that many municipalities do not have policy in place to base CE land tendering goals on. In these cases, circular goals can still be incorporated in the tender. It is therefore not necessary to wait until CE land tendering is in place, before circular goals can be incorporated. In these cases, it would be good to consider the broader context of CE and how the tender goals contribute to a circular city. However, the implementation of circular goals in a land tender, can also help to formulate circular land tendering policy afterwards.

The circular tender process is evaluated in a set of expert interviews, who verified that it represents the process towards a circular land tender. For implementation, some steps might need further elaboration. For example, this study has not taken verification methods during construction and operation into account. The process shows that it must be conducted, but exact methods are not studied. Several experts mentioned that verification is often lacking, incorporating this stronger in the process can therefore help the implementation.

The second set recommendations focuses on the implementation of CE goals in tender criteria. This led to criteria which could be used, to assess the goals of circular materials and adaptive building in a tender. Other than the aspects mentioned in chapter 6, the formulation of criteria can also be dependent on the composition of the project team. Some interviewees mentioned that the formulation of a tender, is a negotiation process. Officials from different departments, have different interests. In this formulation process, a sufficient weight for circular criteria must be established. CE policy can help to strengthen the position of CE, as well as motivated officials with expertise from the subject. The

negotiation will also continue when the tender has been formulated, since real estate developers often accuse municipalities of being over-demanding in tenders. In the interviews with municipal officials, many of them pointed out that they adjusted their demands to be not too demanding. Here, real estate developers have an interest in keeping initial costs as low as possible, these are risky because the tender can still be awarded to another party. Municipalities have an interest in requesting detailed information, to make an informed decision, while at the same time formulating an attractive tender request to invite tenderers to participate. Assessing quality aspects helps to formulate an attractive request, as all developers from the case studies stated they differentiate themselves based on the quality they deliver. Therefore, requesting circularity as one of the quality aspects of a tender can stimulate them to participate. Overall, requesting circularity more often in tenders will increase the familiarity with the subject, making it easier to set higher circular demand.

The proposed criteria for circular materials can be used to stimulate the use of circular materials in proposals. The aim of the criteria was to find a balance between acquiring the right information and not be over-demanding. This is done by making a deviation from the MPG-score, so less information is required. Some interviewees mention that they prefer to stick with current, well known, calculation methods, such as BREEAM or the MPG. However, there is also critics on these methods that they will not lead to the most circular buildings. It is therefore advisable to start experimenting with other assessment methods, to improve current methods. This will lead to a set of tender criteria which are the best in measuring circular goals, and are supported by the sector. Since the tender criteria are not tested in a tender process yet, it cannot be confirmed how tenderers respond. Therefore, it would be good to discuss the criteria in a market dialogue, prior to tendering, to make necessary adjustments. Subsequently when the criteria have been used, they must be evaluated.

The proposed criteria for adaptive buildings aim to quantify the adaptivity in a proposal. This is merely done by existing techniques. However, experience with quantifying adaptivity in a tender is limited. The applicability seems also limited to assessing tenders in the awarding phase, during the operation phase adaptivity will focus on specific functions and include organisation aspects. The organisation aspects are not included in the criteria, while these are important in the current market. Most investors mainly operate specific functions, such as housing or offices, which makes the shift in functions difficult. Flexibility from the investor is necessary, or ownership must be transferred. Some of these organisation aspects can also be requested in a tender. However, on the implications of these criteria additional research is necessary.

Overall, the findings and recommendations must be seen as moving a step further towards circular land tendering. As stated before, the field of CE is rapidly evolving. This means that circular goals and circular criteria must adapt to the market conditions. The formulated criteria are a step further in requesting circularity, but do not define the ultimate goal for circular tender requests. It is therefore important to always keep in dialogue on the possibilities and keep updating policy and the tender requests.

9 Recommendations for future research

This thesis is seen as an exploration towards the theme of circular land tendering. Further research is limited, almost any research which further clarifies this subject can therefore be beneficial. This thesis does provide a few aspects on this subject, which need further investigation.

All the studied cases were still prior to construction phase, making it not possible to study actions in the construction and operation phase. The enforceability of criteria in these phases influences goal and criteria formulation earlier in the process. It is therefore advisable to repeat this study with a focus on criterion enforcement. Additionally, conducted a similar study on different cases, for example in smaller municipalities, can help to generalise the findings from this study.

This thesis has two sets of recommendations, a circular land tender process design and the translation of a circular materials and adaptive building goal into tender criteria. The discussion in chapter 8 mentions the applicability and limitations of the recommendations. To further generalise the recommendations and understand how the criteria will work, more research is required. In the ideal situation, the criteria are implemented in a tender and can be evaluated. This study should focus on the effect of the criteria on tenderers, do the criteria lead to the desired results?

In conclusion, the field of CE is rapidly evolving. The same study might find different conclusions a year later since CE techniques have been further developed. One of the interviewees stated that it was not possible to request material passports from all proposals, but a few years later this was accepted by all the tenderers. Therefore, repeating a similar research in a few years will probably give new insights regarding the development of the field of CE and produce more advanced tender criteria which are proportionate towards the market.

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Photos

Page	Content	source
Title	Wonderwoods, HUQ	https://www.stefanoboeriarchitetti.net/en/ project/wonderwoods/
iv	Treehouse, Delftseplein	https://www.vastgoedmarkt.nl/projectontwikkeling/nieuws/2019/12/ provast-winttender-delftseplein-rotterdam-101150246
8	Ichange, Delft	Own photo
27	Tower of blocks	Own photo
36	Crossover, Zuidas	https://teamv.nl/projecten/crossover-kop-zuidas/
57	Juf Nienke	https://www.openbuilding.co/casestudies/overview/juf-nienke-search
78	Wonderwoods	Own photo

Appendices

11.1 Reflection

11.1.1 Initial proposition

[redacted]

11.1.2 Research method and process

[redacted]

[redacted]

[redacted]

11.1.3 Reflection on subject & contents

[redacted]

[redacted]

[redacted]

[redacted]

11.2 Appendix 2: Interview protocols

11.2.1 Interview protocol case studies

Regarding the case studies the following persons have been interviewed:

1	Gemeente Amsterdam	Marie Krop	Project manager	13-03-2020
2	AM	Francis Kreuger	Project developer	09-03-2020
3	Fakton	Sander v. Engelen	Project developer	24-03-2020
4	Gemeente Rotterdam	Maarten Nypels	Advisor transitions	19-03-2020
5	Provast	Sofie Oosdijk	Project developer	26-03-2020
6	Gemeente Utrecht	Hedzer Pathuis	Project manager	06-03-2020
7	Gemeente Utrecht	Marin Zegers	Ontwikkelaar circulaire economie	20-03-2020
8	GenS	Robert Luyt	Projectontwikkelaar	27-03-2020

The purpose of an interview is to gain enough information on the case which is discussed in each interview. The aim is, together with a desk study into the tender documents, to gain enough information to answer research sub-questions 6 – 10. Interviews can be used to obtain additional information to the documents and to validate conclusions which were made in the desk study.

This is a general interview protocol which is divided into three parts: first 0 is a general introduction to the interview, which will be held with each interviewee. Subsequently the interview protocol is split, where the first part will be asked to the municipality and the second part to the real estate developer. Per case the protocol will be specified, based on the criteria applicable to the case.

The interview will be transcribed, and the interviewee will have the opportunity to correct misunderstandings and mistakes.

Introduction

1. Ik studeer bouwkunde aan de TU Delft, richting ‘Management in the Built Environment’ waar ik nu bezig ben met mijn afstuderen rondom circulair gemeentelijk beleid en het effect daarvan op ontwikkelaars.
2. In mijn afstudeerverslag zal ik uw naam in de interviewlijst noemen en uw functie m.b.t. het project wordt bij het project genoemd. Het interview wordt opgenomen. Aan de hand van die opname maak ik een verslag die nog op eventuele feitelijke onjuistheden gecorrigeerd kan worden.
3. Het interview is volstrekt vrijwillig, mocht u dit willen dan kunt u het op elk moment onderbreken.
4. Is het bovenstaande akkoord, zijn er eventueel nog andere vragen?

Questions for municipality

Intro

1. Wat is uw functie binnen de gemeente?
2. Hoe bent u betrokken geraakt bij het thema circulariteit?
    a. Wat voor projecten heeft u over circulariteit gedaan?
    b. Zijn er ook projecten specifiek over het thema circulair bouwen?
3. We gaan het zo hebben over het circulaire beleid & de tenderuitvraag, hoe bent u daar betrokken bij geweest?

a. Wat was uw rol?
b. Wie zaten in het “team”?

Policy

4. Gebaseerd op het framework met circulaire doelen en overheidsmiddelen, zijn er nog projecten die aansluiten op andere doelen / middelen die ik hierin vergeten ben?
5. Hoe is het circulaire beleid binnen de gemeente tot stand gekomen?
    a. Waar in de organisatie ligt het initiatief voor het beleid?
    b. Hoe speelt circulariteit binnen de organisatie/ wie zijn de sleutelfiguren?
    c. Hoe is de dynamiek tussen het college en de ambtelijke organisatie op het thema?
6. Hoe breed speelt circulair bouwen nu binnen de organisatie?
    a. Wie/ welke afdeling is er nu verantwoordelijk voor de uitvoering van circulair beleid?
    b. In uw beleving, hoe wordt ermee omgegaan op de afdelingen ruimtelijke ordening, grondzaken/vastgoed en andere afdelingen?
7. Wat was het uiteindelijke doel van het beleid?
    a. Gefocust op alle doelstellingen of specifieke doelstellingen? In hoeverre zijn doelstellingen gekwantificeerd?
8. Welk beleid bood aanknopingspunten voor de kwaliteitscriteria van de tender?
    a. Specifiek op het gebied van circulariteit?
    b. Welke aanknopingspunten bood dit beleid voor de kwaliteitscriteria?
    c. Welke criteria? En hoe verdeeld over hoofdcriteria en daarbij horen subcriteria? Welke criteria zijn kwalitatief en welke expliciet kwantitatief?
9. In hoeverre worden publieke aanbestedingen door de gemeente gebruikt om de gemeentelijke doelstellingen voor circulair bouwen te behalen?
    a. Is een tender een geschikt instrument?

Tendering

10. Wanneer en waarom is besloten om circulariteit mee te nemen in de tenderuitvraag?
    a. Welk proces ging hieraan vooraf?
    b. Wat was de aanleiding voor het proces?
    c. Wie waren hierbij betrokken (welke afdelingen)/ wie nam het initiatief?
11. Op basis waarvan zijn de criteria voor circulariteit geformuleerd?
    a. Waren er aanvankelijk andere criteria die betrokken zouden worden, die uiteindelijk toch achterwege zijn gelaten?
12. Op basis waarvan is de score en het gewicht van de criteria tot stand gekomen?
    a. Zowel criteria voor circulariteit als deze criteria in relatie tot andere aspecten zoals prijs en duurzaamheid in het algemeen.
13. Welke criteria waren in deze aanbesteding echt anders dan in vergelijkbare projecten, getenderd door deze opdrachtgever?
    a. Op het vlak van duurzaamheid / circulariteit?
    b. Waren er ook op andere vlakken aspecten die deze tender onderscheiden van wat jullie normaal aanbesteden?
14. Wat was het doel van de criteria?
    a. Wat voor soort ingreep zou er in het ontwerp / bouwproces genomen moeten worden om te voldoen aan het criterium? (denk aan materiaalkeuze, programma, etc.).
    b. Wat was jullie visie op hoe de ontwikkelaar dit het beste zou kunnen bereiken? (denk aan het opstellen van een visie, een adaptief gebouw maken, demontabele componenten)

15. Voldeed de mate en de vorm van circulariteit van de tenderinzendingen aan de verwachtingen?
    a. Waren er zaken die wel beoogd waren, maar niet terugkwamen in de tenderinzendingen?
    b. Werd circulariteit op verschillende manieren uitgevoerd door de verschillende ontwikkelaars/inschrijvers in de tenderinzendingen?
    c. Zat er een grote variëteit in de mate waarin circulariteit was meegenomen in de tenderinzendingen?
    d. Hoe ga je ermee om als bureaus die voor een inschrijver aan tafel zitten bij het indienen van de tender, ook betrokken waren of zijn bij het opstellen van het beleid (Metabolic?)
16. Wat waren volgens jullie de complicerende factoren van criteria voor circulariteit voor de gehele tender?
    a. Op welke andere vlakken had het vooral (een negatief) effect? Bijvoorbeeld financiering of ruimtelijke kwaliteit?
    b. Hebben jullie nog een afweging gemaakt in hoeverre je circulariteitscriteria mee wilde nemen en in hoeverre andere criteria (zoals kosten) belangrijk waren om mee te nemen? Waar werd deze afweging op gebaseerd?
17. Hoe werden de criteria beoordeeld?
    a. Uit wat voor team bestond de beoordelingscommissie? (#mensen & functie)
    b. Mocht iedereen alles beoordelen, of alleen het eigen aspect?
    c. Hoe wordt uiteindelijk gemeten of een circulaire doelstelling is behaald tijdens of na de bouw?
    d. Hoe werden deze criteria uiteindelijk meegenomen in het contract?
18. Hoe zijn de circulaire criteria en beloften van de ontwikkelaar teruggekomen in onderlinge afspreken (contract)?
    a. Zijn alle circulaire afspraken bindend?
    b. Stonden deze vooraf al vast in het contract?
19. In hoeverre hebben de circulaire criteria uiteindelijk een doorslag gegeven bij de beoordeling van de tender?
    a. Was het winnende plan ook het best scorende plan op circulariteit?

Ten slotte

20. Zijn er nog zaken die gemeenten of ontwikkelaars zouden kunnen doen om meer circulaire kansen kunnen pakken bij tenders?
21. Zie je nog bedreigingen voor de circulaire economie die aangepakt zouden moeten worden door ontwikkelaars of gemeenten?
22. Zijn er verder nog aspecten van het project, of in algemene zin over circulariteit die ik vergeten ben? Of waar je de aandacht nog even op zou willen vestigen?

<u>Questions for developer</u>

Intro

1. Wat is uw positie en rol binnen de organisatie?
2. Hoe bent u betrokken geraakt bij het thema circulariteit?
    a. Wat voor soort projecten heeft u over circulariteit gedaan?
    b. Zijn er ook projecten specifiek over het thema circulair bouwen?
3. Wat was uw rol binnen het [deze case] project?
    a. Gedurende het tenderen en gedurende de bouw / nu?
4. Kunt u vertellen hoe er met circulariteit om wordt gegaan binnen jullie organisatie?
    a. Is er een circulaire visie of beleid waar dit soort projecten op gebaseerd kunnen worden?

b. Wie heeft er initiatief genomen voor circulariteit binnen de organisatie, en wie is er nu verantwoordelijk voor de uitvoering van circulariteit?
c. Hoe speelt de circulaire dynamiek binnen de organisatie? Bijvoorbeeld tussen het bestuur en de rest van de organisatie?
d. Hoe wordt een vervolg gegeven aan circulariteit, is er een plan voor de toekomst?

Uitvraag

5. Was het duidelijk dat circulariteit meegenomen wordt in de beoordeling van de tender?
    a. Was het ook duidelijk hoe dit werd meegenomen in de tender?
6. Was dit een reden om mee te doen aan de tender?
    a. Als een tender een hoge doelstelling heeft op circulariteit is dat dan een reden om wel of niet in te schrijven op een tender?
7. Zou je kunnen omschrijven hoe circulair bouwen terugkomt in het gebouw?
    a. In het kader van de 7 aims, komen deze allen terug?
    b. Zijn er circulaire aspecten in het plan, die jullie alleen konden uitvoeren omdat er beoordeeld werd op circulariteit en anders niet meegenomen hadden kunnen worden (bijvoorbeeld omdat ze dan te duur zouden zijn)?
8. Zijn er aspecten van het circulaire beleid van de aanbestedende partij (gemeente) meegenomen in jullie bouwplan?
    a. In hoeverre is dit beleid meegenomen in de planuitwerking?
    b. Zijn er concrete aspecten aan te wijzen?
9. Hoe hebben deze criteria het ontwerp beïnvloed?
    a. Is er extra expertise ingehuurd?
    b. Was ontwerp en proces anders geweest als er geen circulariteitscriteria waren? Hoe was het dan gegaan?
    c. Zijn er concrete onderdelen aan te wijzen in het ontwerp en of proces waar er wijzigingen zijn geweest door de circulaire criteria?
10. Kunt u een vergelijking maken tussen dit project en een ander project waar geen circulaire criteria zijn toegepast? Waar zitten dan de belangrijkste verschillen?
11. Hebben criteria voor circulariteit ook onderdelen in het ontwerp bemoeilijkt?
    a. Waren er ook andere aspecten die meegenomen werden in het plan (bijvoorbeeld ecologie) die bemoeilijkt werden door deze criteria?
    b. Wat was het effect op andere aspecten? Bijv. Businesscase, minder aandacht voor ecologie, ander programma?
12. Zijn er circulaire ideeën geweest voor het gebouw die uiteindelijk niet zijn doorgevoerd?
    a. Welke ideeën en waarom niet?
    b. Zowel ideeën wel ingediend in de tender maar niet uitgevoerd in de bouwfase, als ook ideeën die aanvankelijk bedacht waren maar de tenderinzending niet hebben gehaald.
13. Zijn andere aanbestedingscriteria denkbaar die hetzelfde effect bewerkstelligen?
    a. Welke zijn dat? Zijn die criteria beter / slechter? Waarom?
    b. Worden ontwikkelaars te weinig of juist te veel uitgedaagd in uitvragen?

Gebouw

14. In hoeverre zijn al jullie circulaire doelstellingen geformaliseerd in het contract en worden jullie daar nu aan gehouden?
    a. Welke afspraken staan er in het contract?
    b. Zijn er dingen waar jullie onderuit kunnen?
15. In hoeverre worden alle circulaire aspecten die zijn benoemd in de tenderinzending gerealiseerd?

    a. Waarom worden bepaalde aspecten niet gerealiseerd?
16. Is een tender een geschikt instrument om gebouwen meer circulair te ontwikkelen, of zouden er andere betere instrumenten zijn?
    a. Ook als je de EU en andere regelgeving zou kunnen loslaten.
17. Zijn jullie tegen (gemeentelijke) barrières aangelopen waardoor bepaalde circulaire ideeën juist niet uitgevoerd konden worden?
    a. Bijvoorbeeld in wet-en regelgeving / normstelling?
    b. Ook bijvoorbeeld andere (kwalitatieve) tendercriteria die geleid hebben tot een minder circulair gebouw?

Ten slotte

18. Zijn er nog zaken die gemeenten zouden kunnen doen om meer circulaire kansen kunnen pakken bij ontwikkelaars?
19. Ziet u nog bedreigingen voor de circulaire economie die aangepakt zouden moeten worden door ontwikkelaars of gemeenten?
20. Zijn er verder nog aspecten van het project, of in algemene zin over circulariteit die ik vergeten ben? Of waar u de aandacht nog even op zou willen vestigen?

11.2.2 Interview protocol expert interviews

In a second-round interviews were conducted with experts in the field of circular tendering. Most of the interviewees are consultants in the field of circular land tendering, additionally also a real estate developer who is focused on circular construction was interviewed.

1	Copper8	Noor Huitema	Advisor & Co-Owner	21-04-2020
2	RE:Born	Jouke Hennipman	Building manager	22-04-2020
3	Metabolic	Gerard Roemers	Sustainability advisor	23-04-2020
4	AT-Osborne	Gerben Hofmeijer	Consultant	24-04-2020
5	AT-Osborne	Fanauw Hoppe	Strategic advisor (Legal)	24-04-2020
6	Alba Concepts	Wouter Roemaat	Process manager	28-04-2020
7	PIANOo	Sara Rademaker	Advisor circular procurement	01-05-2020

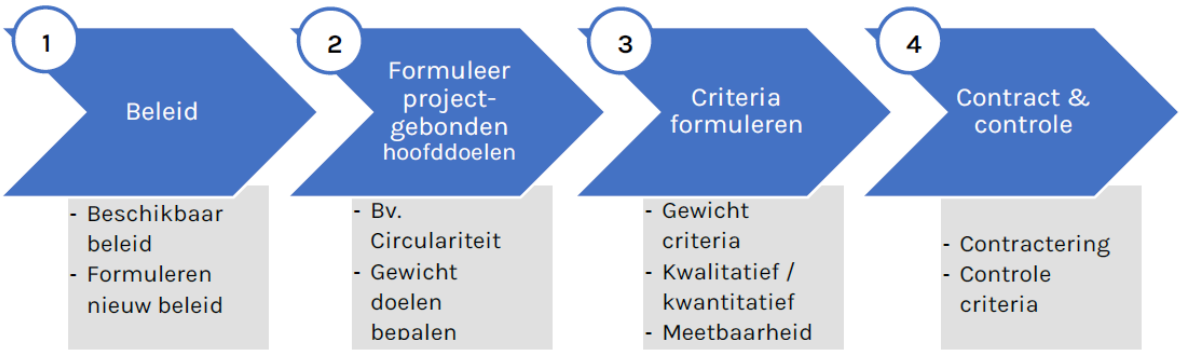
The purpose of an expert interview is to verify conclusions from the case studies and gain new information to bring advice regarding the improvement of circular building policy and the formulation of circular building in tender requests. During the interviews a process design and two tender criteria were shown to the interviewees. These are included in the protocol.

This is a general interview protocol for all the expert interviews, per interviews the questions can vary slightly due to the experience with circular building or procurement from the interviewee.

1. Ik studeer bouwkunde aan de TU Delft, richting ‘Management in the Built Environment’ waar ik nu bezig ben met mijn afstuderen rondom circulair gemeentelijk beleid en het effect daarvan op ontwikkelaars.
2. In de eerste fase heb ik een aantal gemeentelijke tenders bestudeerd, waarbij de gemeente een stuk grond in de markt zet om ontwikkeld te worden, niet voor eigen gebruik.
3. In mijn afstudeerverslag zal ik uw naam in de interviewlijst noemen en uw functie m.b.t. het interview. Het interview wordt opgenomen. Aan de hand van die opname maak ik een verslag die nog op eventuele feitelijke onjuistheden gecorrigeerd kan worden.
4. Het interview is volstrekt vrijwillig, mocht u dit willen dan kunt u het op elk moment onderbreken.
5. Is het bovenstaande akkoord, zijn er eventueel nog andere vragen?

Intro

1. Wat is uw functie?
2. Hoe bent u betrokken geraakt bij het thema circulariteit?
    a. En met circulair bouwen?
    b. En circulair tenderen?
3. Wat voor projecten hebt u gedaan rondom het thema?
4. Wat is volgens u het verschil tussen tenderen op duurzaamheid of tenderen op circulariteit?
    a. Kan circulariteit onderdeel zijn van duurzaamheid in een tender?
    b. Heeft het meerwaarde om circulariteit als apart beoordelingsaspect op te nemen?
5. Wat is volgens u de grootste meerwaarde van circulair tenderen?
    a. Wat is de grootste kans?
    b. Wat is het grootste risico?
6. Wat zijn volgens u belangrijke stappen voor een circulair tenderproces (vanuit de aanbestedende partij)



7. Hoe kijkt u aan tegen dit proces?
    a. Zijn er stappen die missen?

Beleid

8. Wat is volgens u de meerwaarde van beleid rondom circulair tenderen (bij bouwen) voor het formuleren van een tender
    a. Hoe zou dit beleid eruit moeten zien?
    b. Hoe zou het ideale tenderproces eruit moeten zien?

Doelen

9. Zijn er bepaalde doelen die goed te combineren met circulariteit in een tender (zoals architectuur, programma, stedenbouw, etc.)?
    a. Wat voor doelen ziet u vaak terugkomen?
    b. Zijn er doelen die circulariteit tegenwerken?
10. Hoeveel van deze doelen zouden er totaal moeten zijn?

Criteria

11. Wat zijn de belangrijkste criteria [aspecten] voor circulariteit in een tender?
    a. Op het gebied van materialen en adaptiviteit?
12. Wat zijn criteria voor circulariteit waar u ervaring mee heeft?
    a. Waarom kiest u voor bepaalde criteria?
    b. Waar voldoet een goed circulariteitscriterium aan?
13. Verschil in kwantitatief en kwalitatief meten, op basis waarvan bepaalt u hoe u meet?
    a. Welke aspecten voor circulariteit zijn te kwantificeren?
    b. Welke aspecten voor circulartiteit zijn niet te kwantificeren?
    c. Wat moet de verdeling in gewicht tussen kwalitatieve en kwantitatieve criteria moeten zijn?
14. Hoeveel kun je vragen in de tenderfase van een ontwikkelaar qua uitwerking van het ontwerp en daarin de circulaire maatregelen?
15. In hoeverre is BREEAM een geschikt middel om de mate van circulariteit te simuleren in tenderinzendingen? (bijvoorbeeld via een BREEAM Excellent certificaat circulariteit)
    a. Hoe moet een BREEAM score dan gebruikt worden?
    b. Waar zou BREEM verder gespecificeerd kunnen worden?
    c. Wat zijn de voor- en nadelen van BREEAM in tenders?
16. In hoeverre is een MPG-score een geschikt middel om de mate van circulariteit te simuleren in tenderinzendingen?
    a. Hoe moet een MPG score dan gebruikt worden?
    b. Wat zou er nog verbeterd moeten worden aan de MPG?
    c. Wat zijn de voor- en nadelen van een MPG in tenders?
17. Is er een percentage wat u aan houdt voor het gewicht aan circulaire criteria in een aanbesteding?

a. Is er een ondergrens, waaronder het geen zin heeft?
b. Is er een bovengrens, waarboven er geen toegevoegde waarde is?

Contract

18. Hoe wordt, in de processen die u begeleidt, circulariteit verankerd in contracten?
19. Wat zijn belangrijke aspecten om vast te leggen in contracten?
20. Wie controleert of de gemaakt afspraken worden nagekomen?
21. Waar is ook juist flexibiliteit nodig?

Tender ontwerpen

Ik wil graag iets dieper ingaan op criteria voor materialen en adaptiviteit. Waarbij materiaalgebruik gaat over meer hergebruiken en minder ruwe grondstoffen gebruiken. Adaptiviteit gaat over het makkelijker aanpasbaar maken van gebouwen voor andere functies.

22. In hoeverre denkt u dat criteria voor circulair materiaalgebruik en adaptiviteit van een gebouw omvatten waar circulariteit in tenders om gaat?

Materialen

Uit mijn case-onderzoek bleek dat het belangrijk is om een score te hebben die het totale niveau meet, maar die flexibel genoeg is om mee te bewegen als bepaalde bouwingrepen niet mogelijk zijn. Daarop kwam ik op de volgende methode:

R	Betekenis	Criterium	Factor
R1	Rethink	Kg bio-based materialen	X 0,6
R2	Reduce	Kg materialen minder dan referentiegebouw	X 1,0
R3	Re-use	Kg secundaire materialen	X 0,6
R4	Recycle	Kg materialen recyclebaar na afloop	X 0,4

$$\text{Score} = \frac{(\text{kgR1} * 0{,}6) + (\text{kgR2} * 1{,}0) + (\text{kgR3} * 0{,}6) + (\text{kgR4} * 0{,}4)}{m^2\ \text{BVO}}$$

Gebouw 1

	Materiaal	kg
R1	Hout	20
	Bio-kunststof	0
R3	Gerecycled beton	5
	Staal	30
	Beton	40
	kunststof	5
R2	Totaal	100
R4	Recyclebaar na afloop (95%)	95

Gebouw 2

	Materiaal	kg
R1	Hout	40
	Bio-kunststof	5
R3	Gerecycled beton	35
	Staal	20
	Beton	15
	kunststof	5
R2	Totaal	120
R4	Recyclebaar na afloop (95%)	114

Score gebouw 1:

$$\frac{(25 * 0{,}6) + (0 * 1{,}0) + (5 * 0{,}6) + (95 * 0{,}4)}{m^2\ \text{BVO}} = 56$$

Score gebouw 2:

$$\frac{(45 * 0{,}6) + (-20 * 1{,}0) + (35 * 0{,}6) + (114 * 0{,}4)}{m^2\ \text{BVO}} = 73{,}6$$

23. Hoe kijkt u aan tegen deze methode?
24. In hoeverre herkent U de R-stappen?
    a. Zijn deze stappen geschikt om circulariteit van materialen te meten?
25. In hoeverre bevat dit de aspecten die belangrijk zijn voor circulair materiaal in een aanbestedingsproces?
26. Is het haalbaar voor een opdrachtgever om een goed referentiegebouw te definiëren?
27. Is het haalbaar voor indieners om een score uit te werken op basis van deze methode tijdens de tenderprocedure?
28. Wat zijn de voor- en nadelen van deze methode ten opzichte van een uitvraag naar een kwalitatieve visie op circulariteit?
29. Wat zijn de voor- en nadelen van deze methode ten opzichte van een MPG of BREEAM?

Adaptiviteit

Het tweede aspect is adaptiviteit, hierbij heb ik ook gekeken hoe ik dit zo kwantificeerbaar zou kunnen maken. Hier kwamen de volgende aspecten uit:

Criterium	Indicator
% her-indeelbaar vloeroppervlak	0 – 100%
Aantal functies waarvoor het gebouw bouwkundig geschikt te maken is.	0 - 4
Aantal uitgewerkte businesscases voor verschillende functies	0 - 4

30. Hoe kijkt u aan tegen deze methoden?
31. In hoeverre bevat dit de aspecten die belangrijk zijn voor adaptiviteit in een aanbestedingsproces?
32. Is het haalbaar voor indieners om een score uit te werken op basis van deze methode tijdens de tenderprocedure?
33. Hoe staat dit tegenover het uitvragen van een kwalitatieve visie op het gebied van adaptiviteit?
34. Zijn er nog andere belangrijke criteria die meespelen?
35. Wat zou het gewicht van beide criteria moeten zijn binnen circulariteit?

Tot slot

36. Zijn er nog zaken die gemeenten zouden doen om meer circulaire kansen te creëren bij ontwikkelaars?
37. Ziet u nog bedreigingen voor de circulaire economie of circulair bouwen die die ontwikkelaars en gemeenten moeten aanpakken?
38. Zijn er verder nog aspecten over circulair bouwen en tenderen die ik vergeten ben? Of waar u de aandacht nog op zou willen vestigen?

11.3 Appendix 3: Circular tender criteria

	Aim	criterion	Source
Looping	Use looped materials	Declaration of recycled content.	Tarantini et al. (2011)
		Use of recycled materials.	Testa et al. (2015); DBGBC (2014)
		Where an existing asset is on site, carry out a resource optimisation audit/pre-demolition audit to understand the pool of resources available for reuse, reuse with modification, repurpose, refurb or recycling.	UKGBC (2019)
		Where the asset cannot be reused, a percentage of materials (by value and quantity) should be recovered and reused on site or reused elements should be incorporated from offsite locations.	UKGBC (2019)
		Ensure a presumption in favour of retaining most, if not all, of the asset (structure, facade, building services, fixtures and fittings) based on whole life cost modelling.	UKGBC (2019)
		Develop new buildings on brownfield soil.	
	Waste management during construction	Separate waste streams at the construction site	DGBC (2014)
		Ensure all products delivered to site use packaging that is taken back by the supplier for reuse or recycling.	UKGBC (2019)
		Ensure on site waste management is set up to enable reuse, with recycling as a final option	UKGBC (2019)
	Waste management during use	Designate areas for looping waste while the building is in use	DGBC (2014)
	Reusing materials at end of lifetime	Ensure the long-term durability of building elements and services and effective recoverability during maintenance, refurbishment and disassembly.	UKGBC (2019)
		Ensure that the built asset allows for changing climatic conditions. For example, to protect materials from degradation due to environmental conditions, adopt passive design strategies to provide resilience, size systems to cope with future climate scenarios.	UKGBC (2019)
		All elements from the deconstruction phase that cannot be reused on site should be sent to organisations for onward reuse.	UKGBC (2019)
		Ensure that the materials have the option to be taken apart through mechanical and reversable fixings to allow for future reuse	UKGBC (2019)
		Ensure layer independence: the design of building systems and components in layers so that the removal, adjustment or replacement of some elements is feasible.	UKGBC (2019)
		Elements should use standardised design formats to enable future reuse.	UKGBC (2019)
		Work towards <5% 'special' components across standardised and/or modular designs.	UKGBC (2019)
		Require disassembly as a feature of modular construction	UKGBC (2019)
		The material and product manufacturer should outline the future life of the product and how it can be reused or repurposed.	UKGBC (2019)
	Aim	Criterion	Source
Adapting	Adaptable management	Design a robust frame to enable changes in building use, for example design loads.	UKGBC (2019)
		Ensure that the asset has been designed to allow for easy assembly and reconfiguration for alternative future uses for example, design of interior systems for disassembly.	UKGBC (2019)
	Adaptable building	Ensure the built asset allows for flexibility to cope with a diversity of scenarios, e.g. flexible space planning.	UKGBC (2019)
		Develop a 'meanwhile' strategy for more efficient use of the built asset in operation to ensure full utilisation of the space.	UKGBC (2019)
	Aim	Criterion	Source
Regene	Energy regeneration	Localized renewable energy source	Testa et al. (2015)
		Study the possibility of generating renewable energy on site (or close to the site) and installing renewable energy sources if possible	DGBC (2014)

	Eco-system regeneration	Environmental maintenance of the building to support flora and fauna	DGBC (2014)
	Aim	Criterion	Source
Localise	Local energy production	Localized renewable energy source	Testa et al. (2015)
	Use of local materials	Identifying and stimulating materials with a lower environmental impact	DGBC (2014)
	Aim	Criterion	Source
Substitution	Other construction methods	Use of Best available techniques for construction.	Tarantini et al. (2011)
	Use of less harmful (eco) materials	Forbidding chemicals and other harmful materials.	Tarantini et al. (2011)
		Identifying and stimulating materials with a lower environmental impact	DGBC (2014)
		Ensure where new materials are being specified, they should have little or no adverse effect on either the environment or on human health throughout its lifecycle.	UKGBC (2019)
		Use of eco-friendly materials (for example timber).	Testa et al. (2015)
		Chemicals on the Cradle to Cradle Red list will be eliminated.	UKGBC (2019)
		Ensure unnecessary toxic treatments and finishes are avoided. Some finishes can contaminate the substrate in a way that they are no longer reusable or recyclable. This should be avoided unless finishes serve a specific purpose.	UKGBC (2019)
	New business models	Take-back systems for building materials.	Tarantini et al. (2011)
		Ensure all materials with a planned short life span have an agreement with the manufacturer to take back or that they are procured through a service agreement.	UKGBC (2019)
		Explore opportunities for leasing services within the asset – e.g. for ventilation, heating, cooling, lighting, lifts, and facades.	UKGBC (2019)
	Aim	Criterion	Source
Sharing		-	
	Aim	Criterion	Source
Optimisation	Heat	Minimal insulation value and preventing heat leaks	Tarantini et al. (2011); DGBC (2014)
	Energy	Minimise energy use during construction	DGBC (2014)
		Energy Consumption standard or design building for minimal energy use	Testa et al. (2015); DGBC (2014)
		Energy Efficiency training for end-use	Testa et al. (2015)
	Water	Rainwater & grey water use, storing rainwater to manage peak rainwater falls	Testa et al. (2015); DGBC (2014)
		Water facilities equipped with the latest technology (dual-flush, waterless urinals, water saving devices, etc.)	Testa et al. (2015); DGBC (2014)
	Materials	Prolonged warranty for building materials	Tarantini et al. (2011)

Table 25: Criteria for looping in tendering

11.4 Appendix 4: Tender assessment frameworks

All the tenders are assessed, based on a CE assessment table which was made in the graduation thesis of van Haagen (2018). The assessment form which is designed by van Haagen is shown below, subsequently the assessment forms for each tender are discussed.

Tender part	Criterion	Assessment aspect
Description of the contracting authority (7 points)	Formulate a PP company-wide CE vision	1. the PP has no vision on sustainability or CE formulation 2. the PP has an overall vision of sustainability formulated 3. The PP has a general description of CE formulation 4. The PP has a company-wide vision regarding CE formulation 5. The PP has a general description of CE and a company-wide vision regarding to CE formulation
Description of the Tender (5 points)	Formulate an open and functionally specified question.	1. The PP put a completely closed question with an elaborate technical design including specifications. 2. The PP submitted a closed question with a detailed programme of requirements, but no specifications have yet been drawn up. 3. The PP asked an open question with basic elements functionally and/or technically specified. 4. The PP asked an open and functional question, without additional frameworks. 5. The PP asked an open and functional question within a clearly defined framework including planning & budget.
Description of the Tender (5 points)	Translate the company-wide vision in terms of CE to project specific circular ambitions and objectives.	1. The PP has no project-specific ambitions and objectives. 2. The PP has broad and generic sustainability ambitions and formulated objectives. 3. The PP has project-specific CE ambitions and objectives. 4. The PP has translated the company-wide vision regarding circularity to project-specific circular ambitions and objectives. 5. The PP has translated the company-wide vision regarding circularity to, partly quantitative, project-specific circular formulated ambitions and objectives.
Conditions for participation (2 points)	Do not take circularity as exclusion grounds or suitability requirements.	1. the PP has implemented circularity in the grounds for exclusion and/or suitability requirements. 5. the PP has not implemented circularity in the grounds for exclusion and/or suitability requirements.
Further selection criteria (12 points)	Request a vision regarding CE of the tenderers as a selection criterion.	1. The PP did not include a selection criterion for a CE or sustainability vision 2. The PP has included a selection criterion, whereby a vision regarding sustainability is requested. 3. The PP has included a selection criterion, whereby a vision regarding CE is requested. 4. The PP has included a selection criterion, requesting a vision regarding CE and their own role within it. 5. The PP has included a selection criterion requesting a vision regarding CE and re role of the tenderer within it. CE is explicitly assessed within its own aspect.
Further selection criteria (8 points)	Explicitly CE in the assessment of reference projects to assess competence.	1. The PP has neither sustainability nor circularity included as assessment aspects of reference(s).

		2. The PP explicitly includes sustainability as a minimum requirement and taken as one of the assessment aspects of reference(s). 3. The PP has explicitly set circularity as a minimum requirement and considered as one of the assessment aspects of reference(s). 4. The PP requested circularity references, but not explicitly included as one of the assessment aspects of the reference(s). 5. The PP has explicitly included circularity as one of the assessment aspects of reference(s), but not as minimum requirement.
Assessment methodology (3 points)	Make use of a Multidisciplinary assessment team, where assessors individual and independent of each other in absolute terms judge wisely.	1. Relative assessment with a single disciplinary assessment team of less than five assessors, where the marks established as average or with consensual consultations. 2. Relative assessment with a single disciplinary assessment team of at least five assessors, where the marks established as average or with consensual consultations. 3. Relative assessment with a multidisciplinary assessment team of at least five assessors, where the marks established as average or with consensual consultations. 4. Absolute assessment with a multidisciplinary assessment team of less than five assessors, where the marks established as average or with consensual consultations. 5. Absolute assessment with a multidisciplinary assessment team of at least five assessors, where the marks established as average or with consensual consultations.
Plenary meeting (to be judged only in the case of non-public procedure) (11 points)	Organize a plenary meeting for all candidates.	1. The PP did not organise a plenary meeting. 2. The PP organised a plenary meeting.
Dialogue phase (only at appraise at competitive dialogue) (11 points)	Organize two plenary dialogue sessions and at least one individual round of dialogue.	1. The PP conducted only individual dialogue sessions. 2. The PP only held plenary dialogue sessions. 3. The PP has launched an individual dialogue session; and ended with an individual dialogue session. 4. The PP has started a plenary dialogue session and ended with an individual dialogue session. 5. The PP has started a plenary dialogue session, has then at least one individual round of dialogue and has concluded the dialogue phase with a plenary dialogue session.
Award criteria (8 points)	Give price a maximum weight of 30% within assessment	1. The criterion 'price' has a higher weighing than 30% in relation to the quality criteria granted. 2. The criterion 'price' has a lower weighing than 30% in relation to the quality criteria granted.
Award criteria (12 points)	Combine qualitative and quantitative award criteria relating to technical aspects of circularity.	1. The PP has neither sustainability nor circularity included in the award criteria. 2. The PP did not explicitly include circularity but categorised under award criteria relating to sustainability in general. 3. The PP has included quantitative award criteria for the assessment of the technical content aspects regarding circularity. 4. The PP has included qualitative award criteria for the assessment of the technical aspects regarding circularity. 5. The PP has included qualitative and quantitative award criteria for the assessment of the technical content aspects of circularity.

Award criteria (14 points)	Combine qualitative and quantitative award criteria relating to process-based aspects of circularity.	1. The PP has not included any award criteria addressing the process-related aspects of circularity or sustainability. 2. The PP did not include any award criteria addressing the process-related aspects of circularity, but categorised under award criteria relating to sustainability in general. 3. The PP has included quantitative award criteria that address the process-related aspects of circularity. 4. The PP has included qualitative award criteria that address the process-related aspects of circularity. 5. The PP has qualitative and quantitative award criteria included that deal with the process aspects regarding circularity.
Award criteria (only mark as price is not included as award criterion) (8 points)	Take a qualitative award criterion in terms of financial-economic aspects of circularity.	1. The PP has no qualitative award criteria Included, including financial and economic aspects of circularity. 2. The PP has included qualitative award criteria, including financial and economic aspects of circularity.
Award criteria (assessment only if price is included as an award criterion) (8 points)	Combine qualitative and quantitative award criteria if price becomes taken as award criterion.	1. The PP calculates the quantitative award criterion price only based on initial investment costs. 2. The PP calculates the quantitative award criterion price only based on initial investment costs and calls for a qualitative substantiation of the calculation. 3. The PP calculates the quantitative award criterion price based on total life cycle costs. 4. The PP shall calculate the quantitative award criterion based on basis of life-cycle costs and requires a qualitative substantiation of the calculation. 5. The PP shall calculate the quantitative award criterion based on life-cycle costs, requires a qualitative substantiation of the calculation and the direct financial consequences by circularity.

This form by van Haagen has been slightly changed for the purpose of this graduation thesis. In the model by van Haagen (2018) two criteria were defined regarding meetings, one specific for a non-public procedure and one only applicable for a competitive dialogue procedure. Because public parties are less flexible in choosing their procuring method the aspects have been merged into one criterion in the assessment of the case study tenders. This criterion consist of two different kinds of meetings with the tenderer(s). Firstly, a market dialogue prior to tendering can be held to understand what the market can offer regarding CE, to improve the formulated tender request and get better tender entries (Sönnichsen & Clement, 2019; van Haagen, 2018).

Additionally, the assessment criteria regarding price have been changed. Van Haagen (2018) assesses these based on that price should never weight more than 30%. Because this is the case with all the cases, it is assessed what the weight of the circular criteria is.

		- -	-	+ / -	+	+ +
Preparation	Formulate a company-wide vision	No sustainability or CE vision	Overall sustainability vision	General CE description	Company-wide CE vision	General description & CE vision
	Translate company-wide CE vision in project specific goals	No specific ambitions	Broad & generic sustainability objectives	Project specific CE objectives (without vision link)	Vision translated in project specific objectives	Vision translated in, partly quantitative, project objectives
	Open & functionally specified tender	Closed question with technical specifications	Closed question without technical specifications	Open question with basic elements technical specified	Open & functional question without framework	Open & functional question with framework
Selection phase	Sustainability as exclusion ground	CE criteria as exclusion ground				No CE criteria as exclusion ground
	CE vision request as selection criterion	No CE or sustainability vision selection criterion	Sustainability vision selection criterion	CE vision selection criterion	CE vision required with role of tenderer in CE	CE vision with tenderer role explicitly assessed
	CE assessment in reference project	No sustainability or CE part of assessment	Sustainability as minimum requirement & part of reference assessment	CE as minimum requirement & part of reference assessment	Specific CE references, not explicitly assessed	Specific CE references, not as minimum requirement
	Dialogue and meeting	No meetings are held with tenderers	Only individual meetings were held with procuring party prior to the tender	A plenary market dialogue was held with procuring parties prior to the tender	A competitive dialogue procedure was in place with sessions with tenderers	A market dialogue was held prior to tendering & a competitive dialogue procedure is in place
Awarding	Combine qualitative & quantitative criteria regarding CE techniques	no sustainability or CE criteria in awarding phase	CE techniques are included in sustainability criteria	Quantitative award criteria for CE assessment	Qualitative award criteria for CE assessment	Quantitative & qualitative CE assessment criteria
	Combine qualitative & quantitative criteria regarding CE process	No sustainability or CE process criteria in awarding phase	CE process is included in sustainability criteria	Quantitative award criteria regarding CE process	Qualitative award criteria regarding CE process	Quantitative & qualitative CE process criteria
Assessment	Tender Assessment	Relative assessment by single disciplinary team of < 5 people	Relative assessment by single disciplinary team of > 5 people	Relative assessment by multidisciplinary team of < 5 people	Absolute assessment by multidisciplinary team of < 5 people	Absolute assessment by multidisciplinary team of > 5 people
	Circular criteria assessment	< 10% sustainability criteria	≥ 10 % sustainability criteria	≥ 30% sustainability criteria	≥ 30% weight for sustainability criteria with CE aspects	≥ 30% weight for CE criteria
	Quantitative & qualitative price assessment	Only initial investment costs are calculated	Investment costs with qualitative substantiation	Price calculated based on Total Cost of Ownership (TCO)	TCO price calculation with qualitative substantiation	TCO price calculation with qualitative substantiation & financial consequences of CE

Table 26: Procurement process possibilities in tender request Kop Zuidas assessed

		- -	-	+ / -	+	+ +
Preparation	Formulate a company-wide vision	No sustainability or CE vision	Overall sustainability vision	General CE description	Company-wide CE vision	General description & CE vision
	Translate company-wide CE vision in project specific goals	No specific ambitions	Broad & generic sustainability objectives	Project specific CE objectives (without vision link)	Vision translated in project specific objectives	Vision translated in, partly quantitative, project objectives
	Open & functionally specified tender	Closed question with technical specifications	Closed question without technical specifications	Open question with basic elements technical specified	Open & functional question without framework	Open & functional question with framework
Selection phase	Sustainability as exclusion ground	CE criteria as exclusion ground				No CE criteria as exclusion ground
	CE vision request as selection criterion	No CE or sustainability vision selection criterion	Sustainability vision selection criterion	CE vision selection criterion	CE vision required with role of tenderer in CE	CE vision with tenderer role explicitly assessed
	CE assessment in reference project	No sustainability or CE part of assessment	Sustainability as minimum requirement & part of reference assessment	CE as minimum requirement & part of reference assessment	Specific CE references, not explicitly assessed	Specific CE references, not as minimum requirement
	Dialogue and meeting	No meetings are held with tenderers	Only individual meetings were held with procuring party prior to the tender	A plenary market dialogue was held with procuring parties prior to the tender	A competitive dialogue procedure was in place with sessions with tenderers	A market dialogue was held prior to tendering & a competitive dialogue procedure is in place
Awarding	Combine qualitative & quantitative criteria regarding CE techniques	no sustainability or CE criteria in awarding phase	CE techniques are included in sustainability criteria	Quantitative award criteria for CE assessment	Qualitative award criteria for CE assessment	Quantitative & qualitative CE assessment criteria
	Combine qualitative & quantitative criteria regarding CE process	No sustainability or CE process criteria in awarding phase	CE process is included in sustainability criteria	Quantitative award criteria regarding CE process	Qualitative award criteria regarding CE process	Quantitative & qualitative CE process criteria
Assessment	Tender Assessment	Relative assessment by single disciplinary team of < 5 people	Relative assessment by single disciplinary team of > 5 people	Relative assessment by multidisciplinary team of < 5 people	Absolute assessment by multidisciplinary team of < 5 people	Absolute assessment by multidisciplinary team of > 5 people
	Circular criteria assessment	< 10% sustainability criteria	≥ 10 % sustainability criteria	≥ 30% sustainability criteria	≥ 30% weight for sustainability criteria with CE aspects	≥ 30% weight for CE criteria
	Quantitative & qualitative price assessment	Only initial investment costs are calculated	Investment costs with qualitative substantiation	Price calculated based on Total Cost of Ownership (TCO)	TCO price calculation with qualitative substantiation	TCO price calculation with qualitative substantiation & financial consequences of CE

Table 27: Procurement process possibilities in tender request Kavel 14-01 assessed

		- -	-	+ / -	+	+ +
Preparation	Formulate a company-wide vision	No sustainability or CE vision	Overall sustainability vision	General CE description	Company-wide CE vision	General description & CE vision
	Translate company-wide CE vision in project specific goals	No specific ambitions	Broad & generic sustainability objectives	Project specific CE objectives (without vision link)	Vision translated in project specific objectives	Vision translated in, partly quantitative, project objectives
	Open & functionally specified tender	Closed question with technical specifications	Closed question without technical specifications	Open question with basic elements technical specified	Open & functional question without framework	Open & functional question with framework
Selection phase	Sustainability as exclusion ground	CE criteria as exclusion ground				No CE criteria as exclusion ground
	CE vision request as selection criterion	No CE or sustainability vision selection criterion	Sustainability vision selection criterion	CE vision selection criterion	CE vision required with role of tenderer in CE	CE vision with tenderer role explicitly assessed
	CE assessment in reference project	No sustainability or CE part of assessment	Sustainability as minimum requirement & part of reference assessment	CE as minimum requirement & part of reference assessment	Specific CE references, not explicitly assessed	Specific CE references, not as minimum requirement
	Dialogue and meeting	No meetings are held with tenderers	Only individual meetings were held with procuring party prior to the tender	A plenary market dialogue was held with procuring parties prior to the tender	A competitive dialogue procedure was in place with sessions with tenderers	A market dialogue was held prior to tendering & a competitive dialogue procedure is in place
Awarding	Combine qualitative & quantitative criteria regarding CE techniques	no sustainability or CE criteria in awarding phase	CE techniques are included in sustainability criteria	Quantitative award criteria for CE assessment	Qualitative award criteria for CE assessment	Quantitative & qualitative CE assessment criteria
	Combine qualitative & quantitative criteria regarding CE process	No sustainability or CE process criteria in awarding phase	CE process is included in sustainability criteria	Quantitative award criteria regarding CE process	Qualitative award criteria regarding CE process	Quantitative & qualitative CE process criteria
Assessment	Tender Assessment	Relative assessment by single disciplinary team of < 5 people	Relative assessment by single disciplinary team of > 5 people	Relative assessment by multidisciplinary team of < 5 people	Absolute assessment by multidisciplinary team of < 5 people	Absolute assessment by multidisciplinary team of > 5 people
	Circular criteria assessment	< 10% sustainability criteria	≥ 10 % sustainability criteria	≥ 30% sustainability criteria	≥ 30% weight for sustainability criteria with CE aspects	≥ 30% weight for CE criteria
	Quantitative & qualitative price assessment	Only initial investment costs are calculated	Investment costs with qualitative substantiation	Price calculated based on Total Cost of Ownership (TCO)	TCO price calculation with qualitative substantiation	TCO price calculation with qualitative substantiation & financial consequences of CE

Table 28: Procurement process possibilities in tender request Delftseplein assessed

		- -	-	+ / -	+	+ +
Preparation	Formulate a company-wide vision	No sustainability or CE vision	Overall sustainability vision	General CE description	Company-wide CE vision	General description & CE vision
	Translate company-wide CE vision in project specific goals	No specific ambitions	Broad & generic sustainability objectives	Project specific CE objectives (without vision link)	Vision translated in project specific objectives	Vision translated in, partly quantitative, project objectives
	Open & functionally specified tender	Closed question with technical specifications	Closed question without technical specifications	Open question with basic elements technical specified	Open & functional question without framework	Open & functional question with framework
Selection phase	Sustainability as exclusion ground	CE criteria as exclusion ground				No CE criteria as exclusion ground
	CE vision request as selection criterion	No CE or sustainability vision selection criterion	Sustainability vision selection criterion	CE vision selection criterion	CE vision required with role of tenderer in CE	CE vision with tenderer role explicitly assessed
	CE assessment in reference project	No sustainability or CE part of assessment	Sustainability as minimum requirement & part of reference assessment	CE as minimum requirement & part of reference assessment	Specific CE references, not explicitly assessed	Specific CE references, not as minimum requirement
	Dialogue and meeting	No meetings are held with tenderers	Only individual meetings were held with procuring party prior to the tender	A plenary market dialogue was held with procuring parties prior to the tender	A competitive dialogue procedure was in place with sessions with tenderers	A market dialogue was held prior to tendering & a competitive dialogue procedure is in place
Awarding	Combine qualitative & quantitative criteria regarding CE techniques	no sustainability or CE criteria in awarding phase	CE techniques are included in sustainability criteria	Quantitative award criteria for CE assessment	Qualitative award criteria for CE assessment	Quantitative & qualitative CE assessment criteria
	Combine qualitative & quantitative criteria regarding CE process	No sustainability or CE process criteria in awarding phase	CE process is included in sustainability criteria	Quantitative award criteria regarding CE process	Qualitative award criteria regarding CE process	Quantitative & qualitative CE process criteria
Assessment	Tender Assessment	Relative assessment by single disciplinary team of < 5 people	Relative assessment by single disciplinary team of > 5 people	Relative assessment by multidisciplinary team of < 5 people	Absolute assessment by multidisciplinary team of < 5 people	Absolute assessment by multidisciplinary team of > 5 people
	Circular criteria assessment	< 10% sustainability criteria	≥ 10 % sustainability criteria	≥ 30% sustainability criteria	≥ 30% weight for sustainability criteria with CE aspects	≥ 30% weight for CE criteria
	Quantitative & qualitative price assessment	Only initial investment costs are calculated	Investment costs with qualitative substantiation	Price calculated based on Total Cost of Ownership (TCO)	TCO price calculation with qualitative substantiation	TCO price calculation with qualitative substantiation & financial consequences of CE

Table 29: Procurement process possibilities in tender request HUQ assessed

		Kop Zuidas	Kavel 14-01	Delftseplein	HUQ
Preparation	Formulate a company-wide vision	+ +	+ +	+ +	-
	Translate company-wide CE vision in project specific goals	-	+	-	-
	Open & functionally specified tender	+ +	+ +	+ +	+ +
Selection phase	Sustainability as exclusion ground	+ +	++	+ +	+ +
	CE vision request as selection criterion	-	+/ -	-	-
	CE assessment in reference project	-	+ +	- -	- -
	Dialogue and meeting	+	+ +	+	+
Awarding	Combine qualitative & quantitative criteria regarding CE techniques	+ +	+ +	-	+/ -
	Combine qualitative & quantitative criteria regarding CE process	- -	- -	- -	- -
Assessment	Tender Assessment	+ +	+	+ +	++
	Circular criteria assessment	+	+ +	+	-
	Quantitative & qualitative price assessment	- -	- -	-	+

Table 30: *Procurement process possibilities assessment of the four cases compared*

11.5 Extensive case descriptions

11.6 Amsterdam: Kop Zuidas

The Zuidas is a business district located around the southern part of the Amsterdam ring road. The area is currently a business district for the city of Amsterdam, but it will change in the coming years. In the development plans of the municipality it will turn into a more mixed-use neighbourhood with one million additional square meter of offices, housing, and amenities to be developed. The tender for 'Kop Zuidas' is positioned as the first part of this larger development (Gemeente Amsterdam, 2017d).

The tender brochure (Gemeente Amsterdam, 2017d) describes the Kop Zuidas-project as a part of this bigger development in the area. The project must interact with small scale residential neighbourhood on one side and larger scale buildings next to the highway on the other side. This connection should be visible in the architecture and programme of the building, as a mixed-use programme with a maximum of 24.000 m^2 is allowed at the location, with functions of offices, amenities, housing, and parking.

11.6.1 Municipal Policy

Amsterdam has an extensive amount of policy regarding circularity and wants to be one of the frontrunners regarding CE (Gemeente Amsterdam, 2015a). In 2015 the CE ambitions became official when the municipal council of Amsterdam adapted the vision 'Duurzaam Amsterdam' (Sustainable Amsterdam) which has five goals: sustainable energy, clean air, circular economy, climate resilient city, and sustainable municipality (Gemeente Amsterdam, 2015b). In the same year, a sperate circular vision was launched, which launches seven circular goals for two value chains: the construction sector and organic waste flows (Gemeente Amsterdam, 2015a). Several scenarios are studied and based on economic and environmental criteria the municipality chooses to implement a top three action plan regarding the construction industry (Gemeente Amsterdam, 2015a):

9. Steering in land tendering and designate areas for temporary storage of materials
10. Stimulating high value reuse as a launching customer and develop procurement guidelines
11. Stimulate material passports and contribute to the development of guidelines.

These action points are translated into two new circular policy documents 'Amsterdam circulair: leren door te doen' (Amsterdam circular: learning by doing) and 'Circulair innovatieprogramma' (Circular innovation programme). The latter one is focussed on collaborations with businesses and knowledge institutions such as universities to research the material streams in the city. The objective is to define possible looping opportunities and to study these in living labs (Gemeente Amsterdam, 2016b). The other vision, Amsterdam circular: learning by doing, focusses on the projects initiated by the municipality itself. The focus in this document is also to research what is possible, together with initiating pilot projects. The role of the municipality as procuring party is an important aspect and the municipality wants to start pilot projects for a circular area development (Gemeente Amsterdam, 2016a). One aspect of these circular area developments is by steering on CE in land tendering initiated by the municipality. The 'roadmap circulaire gronduitgifte' (roadmap circular land tendering) was developed as guideline for the municipality how CE can be integrated in tender requests. Because this roadmap was used in the tender request for Centrumeiland 14-01 the next paragraph elaborates on this roadmap.

The roadmap circular land tendering is produced by two consultancy firms, commissioned by and in collaboration with the municipality of Amsterdam. The objective was to come with a plan to make circularity measurable, stimulate circular design and make a step-by-step-plan for the land tendering department (commissioned advisor, personal communication, April 23, 2020). Four principles and five CE themes have been defined,

illustrated in Figure 15, leading to a categorisation of tender criteria per theme, per principle (Roemers & Faes, 2017). This leads for example in a criterion for the reduction of materials: the material use during the lifetime or a criterion for the water synergy: reusing water nutrients. The purpose of these criteria is to be incorporated as tender criterion in the selection or awarding phase of a tender.

Principles	Reduction	Synergy	Production & Procurement	Management

Themes	Materials	Adaptivity & Resilience	Water	Energy	Ecosystem & biodiversity

Figure 22: Principles & Themes Roadmap Circular Land Tendering Amsterdam

Prior to determining which criteria can be incorporated, a four-step plan is drawn in the roadmap for circular land tendering. First the existing situation must be studied, to how circularity can be integrated in a plot. The procuring party should ask oneself what kind of infrastructure is present on site, the presence and type of a heating net will for example affect how the building is heated and if an oversupply of heat can be exchanged. Secondly the procuring party determines an ambition level for the plot, in most cases this will mean a focus is brought in the number of criteria, to a few focus areas. In the third phase the main structure of the tender is determined. The roadmap describes that the procuring party should be aware that not too much is asked from the market, therefore the criteria should not demand too specific tender proposals. The procuring party can use quantitative criteria to focus on ambitions which they find important added with qualitative criteria to give sufficient room for innovation to the market. The final step is formulating the tender request and doing a check whether the criteria meet the ambitions and are not conflicting.

When the goals of the circular vision of the Amsterdam municipality are compared with the circular aims, *Table 30* shows that five of the seven aims are adopted in one of the main municipal circularity goals. The aims of sharing and optimising are not adopted in one of the principles, the latter one is incorporated in the umbrella sustainability policy. As discussed in the previous paragraph sharing is not incorporated in any of the circular policy action points.

Table 31: Confronting the Amsterdam CE principles with the circular aims

	Amsterdam Circular, seven CE principles	Circular aim
1.	There is no waste, all materials are used in an infinite biological and technical loop	Looping
2.	All energy derives from renewable sources	Regeneration
3.	Materials are used to create (financial or other) value	Looping
4.	Modular and flexible design of products and product chains enlarges the resilience of the system	Adapting
5.	From owned goods to the use of services, which requires new business models for production, distribution, and consumption	Substitution
6.	The logistic system changes, more focused on the region and return logistics	Localise
7.	Human activities contribute to ecosystems and the reconstruction of 'natural capital	Regeneration

Out of the studied municipalities Amsterdam is the only one who has published an evaluation of their circular policy (Gemeente Amsterdam, Circle economy, & Copper8, 2018). The construction sector, together with the biomass & food & consumer goods, is seen as the area where the municipality can scale up CE policy. This evaluation states that due to the efforts of the municipality of Amsterdam, the construction sector accelerated

CE initiatives. One of the evaluated policies is the circular land tendering policy, where is concluded that there is a need for simple to implement circular criteria. The municipality wants to use their procuring power more.

11.6.2 Tender request

The tender request was put out in the market in 2017 with the goal to develop a mixed-use building, which answers the demands on sustainability, housing for youth and elderly, amenities, etc. In two stages the winning tenderer is selected to construct on the plot. As tender request two brochures were made, one for the selection phase and a second one for the awarding phase. The brochures describe the current situation, the ambitions and what the municipality expects as tender proposals (Gemeente Amsterdam 2017c; Gemeente Amsterdam 2017d). Officially the tender for Kop Zuidas is one of the three pilot projects where the roadmap circular land tendering should be used. However, the tender request was already in the formulation process, thus the roadmap was not explicitly used (sustainability advisor Amsterdam, personal communication, February 18, 2020). The tender request does involve two other policy documents, the Amsterdam sustainability policy and the vision for the area, 'Visie Zuidas 2016'. This vision for the area mentions principles for land tendering, which are shown in Table 31 as the goals of the area vision (Gemeente Amsterdam, 2016c). Additional to these principles for land tendering the vision describes that there is an opportunity for CE principles in the area, with waste separation and reuse, but these principles are not concretised in recommendations for tenders.

These visions have been translated into tender goals which are stated in the 'building envelope A10-strip fase 1 – Kop Zuidas' document, also added in the tender document (Gemeente Amsterdam, 2017a). This document mainly discusses the building restrictions, such as building heights, the availability of utilities, wind, and noise. In the paragraph on sustainability the document mentions circular economy with the ambition of to use as less as possible virgin materials and loop materials for as long as possible. Additionally, the ambitions for the capacity for storing rainwater, green roofs and sustainable mobility are mentioned in this vision. Table 31 shows the goals from the vision for the area and the plot, with an interpretation which to which circular aim they belong.

Table 32: CE goals Kop Zuidas vision categorised as circular aims

Goals		Aim
Area vision	BREEAM excellent	Unspecified
	Energy neutral building	Regeneration
	Flexible, multifunctional buildings (3,3 m.+ floor-to-ceiling)	Adapting
	Use of city heat network & ground source heat	Unspecified
Plot vision	Use as less as possible virgin materials	Looping
	Rainwater storage & green roofs	Regeneration
	Sustainable mobility	Unspecified

In the selection phase of the tender the municipality assesses four criteria (Gemeente Amsterdam, 2017d):

Organisational profile	15 %
Concept & Programme	40%
Quality	30 %
Sustainability	15 %

As part of the organizational profile tenderers submit reference projects, which will be assessed based on their similarity with the Kop Zuidas project, their added value for the project and sustainability. Regarding sustainability the tenderers should draw up a two-

page vision in which the municipality explicitly challenges tenderers to focus on circular building, sustainable mobility, and innovation.

The awarding phase has limited the number of tenderers to four parties. In this phase there are three criteria to assess the proposals (Gemeente Amsterdam, 2017c):

Programme	30%
Design	40 %
Sustainability	30 %

For the criterion of sustainability the municipality requests tenderers to make their proposals as quantifiable as possible. The criterion of sustainability consists out of 30 points, 10 can be earned by BREEAM certification and 20 for the elaboration of the sustainability vision of the selection phase. Regarding the BREEAM criterion, a BREEAM Excellent certificate is required as minimum performance to score. Subsequently a higher BREEAM score will result in a higher score on the BREEAM criterion.

20 points can be earned by an elaboration of maximum 10 pages of the sustainability vision of the selection phase. Although the municipality does not explicitly specify on what basis the sustainability visions are assessed, the minimum contents are specified (Gemeente Amsterdam, 2017c). These minimum contents are displayed in Table 32, together with the criteria in the selection phase, phase 1. The criteria are than interpret among the seven circular aims by Williams.

Table 33: CE criteria Kop van Zuid request categorised as circular aims

Criteria		Type	Aim
Sustainability vision phase 1 includes:	Circular construction	Qualitative	Looping
	Sustainable mobility	Qualitative	Unspecified
	Innovation	Qualitative	Unspecified
Sustainability assessment phase 2	Achieved BREEAM score	Quantitative	Unspecified
	Sustainability vision	Qualitative	Unspecified
Sustainability vision phase 2 minimum contents	Adequate explanation of the vision	Qualitative	Unspecified
	The extent to which circular construction and sustainable mobility have been implemented	Qualitative	Looping / unspecified
	The extent to which greenery on the plot or the building (courtyards, facades, and roofs) is applied in an intensive and high-quality manner. This means that greenery must be attractive, contribute to biodiversity, be usable and accessible	Qualitative	Regeneration
	The extent to and by what means water storage is applied, preferably in combination with the use of greenery	Qualitative	Regeneration
	The extent to which the sustainability ambitions included in the vision have been quantified, such as a specific EPC, the number of m2 of high-quality green space, the amount (m^3) of water storage and the percentage of reuse of materials, etc., are quantified	Qualitative	Unspecified
	Description of the chosen measures and how these contribute to the	Qualitative	Unspecified

achievement of the described ambition in the vision		
The extent to which innovation is applied and the extent to which current technologies are used	Qualitative	Unspecified
Description of the feasibility of the chosen sustainability measures	Qualitative	Unspecified
Description of the measures taken to promote living comfort, quality of living, health, and the indoor environment to the extent that these measures are not already included in the Building Decree and/or the Basic Quality of Housing in Amsterdam	Qualitative	Unspecified
Description of how sustainability and climate neutrality form an integral part of the design	Qualitative	Unspecified

The assessment of proposals is done by an urban planner, sustainability manager, land affairs project manager, planning advisor / risk analyst, and a project manager who assign points for each criterion. As stated, the sustainability vision has a weight of 30%, in which the attention given to CE aspects is weighted. A price bid for the plot is not part of the assessment, the municipality charges fixed ground lease prices per programme function of the plot. This means developers must calculate this bid in their offer and see what they can realise for the price.

11.6.3 Tender proposal

The winning tender proposal is the building 'CrossOver', an energy neutral mixed-use building with green rooftop gardens in a mix of housing, working, learning, and sharing. The residential programme focusses mainly on starters and residence permit holders, who live in studios and share co-living space. (AM, Team V, Valstar Simonis, DGMR, & Pieters Bouwtechniek, 2020).

In an interview with the project developer of the building he states that the focus on quality in the tender request was a reason to participate (personal communication, March 3, 2020). At the moment of tendering the company did not have a vision regarding circularity, so to incorporate the sustainability criteria in the proposal the sustainability advisor of the development company was involved in the process. Due to personnel changes at the development company it is not exactly clear if more people were involved during this phase and how the proposal was made.

The tender proposal of the developer consists mainly out of a bidbook, where the developer explains how the tender request is answered. A higher BREEAM Outstanding certificate is part of this bidbook, with a score of 94,8% this was the highest BREEAM score for a partly residential building in the Netherlands when the bidbook was presented (AM, 2017). Additionally, the paragraph on circularity mentions three ways to build in a circular manner (AM, 2017):

- 40% circular materials
- High extent of prefab (to prevent waste)
- Reuse percentage of 98%

Circular materials refer to the materials used for construction, it is expected that a minimum of 40% of the materials used are bio-based or recycled. The reuse percentage of 98% refers to the end of life of the building, the proposal guarantees that 98% of the

building materials can be recycled. This is ensured by incorporating a material passport where all materials are registered. These numbers are supported by design measures which are described in the bidbook. The façade is for example constructed with bricks made from recycled ceramic waste.

On the other aims of the CE assessment framework the bidbook mentions that the building is adaptable because the offices can be easily transformed into housing due to the high floor-to-ceiling height and the modular with of the offices. The building (re)generates electricity with PV-cells on the roof and in the façade, in the energy calculations this results in a building which generates more electricity than it uses. Additionally, these PV-cells are connected to a DC-net which provides energy to the lighting system, to optimize the energy use. The building has green roofs, where the plants can accommodate water to absorb peak rainfall. In the carpark carsharing is facilitated with 10 parking spots for electric shared cars and a common laundry room uses a new business case for pay-per-use laundry machines, which stay in ownership by the supplier with a take-back guarantee. These measures are also displayed in Table 33, where they are interpreted among the seven circular aims. Almost all aims were addressed in the bidbook, except for the aim of localising.

Table 34: CE measures Kop Zuidas proposal categorised as circular aims

Measures	Type	Aim
BREEAM Outstanding	Quantitative	Unspecified
40% circular materials	Quantitative	Looping
98% of materials reusable	Quantitative	Looping
Recycled bricks in façade	Qualitative	Looping
Office can be easily transformed to housing	Qualitative	Adapting
Energy neutral building (energy production & minimise consumption)	Quantitative	Regeneration / optimising
Green roofs	Qualitative	Regeneration
Car sharing parking (10 spots)	Quantitative	Sharing
Pay-per-use laundry machines	Qualitative	Substitution

These measures to fulfil the CE aims were included in the bidbook to answer the tender request by the municipality. Because sustainability was given a weight of 30% in the criteria a real estate developer wants to score on these subjects. In the case of the façade bricks this meant the real estate developer chose the more expensive circular variant to score on sustainability. (Project developer, personal communication, March 3, 2020).

11.6.4 Building contract

Although it was not possible to see the building contract itself, for this case or for any of the other cases, in all the interviews was asked how the measures from the tender request and tender proposal were formalised and enforced during the development.

The project developer of the building admitted some of the proposed solutions were not found to be feasible during later stages (personal communication, March 3, 2020). An example of this is the bricks in the façade, which were made of recycled ceramic waste. These had been used in smaller projects before, but they were not yet certified and experience with the bricks was limited. In a dialogue with the municipality, it was agreed that it would be better to replace these bricks with common bricks because they knew these bricks would last for a long time span, which was uncertain for the circular bricks. However, later in the process the recycled bricks became certified and they are back in the design. Overall, the project developer stated that in these cases it is good to stay in dialogue with the municipality, they did not want bricks which only lasted for a short

period of time either. In this case the solution of recycled bricks was ‘soft’ in the contract. However, the percentage of 40% circular materials is a hard number which is incorporated in the building contract. If the bricks were replaced with a non-circular alternative this would have to be compensated in another aspect of the building.

The project developer also mentioned that it is difficult to prove the 40% of circular materials and the other 2 circular criteria in the contract: high extent of prefab materials and a reuse percentage of 98%. In the case of this last criterion it was agreed that a material passport would provide evidence. Apart from this the municipality and developer are searching for methods to prove the circular extent of the building. This happens in collaboration; the municipality asks the developer how it can be proved. On their turn the developer has an internal group of people studying how the evidence can be provided (personal communication, March 3, 2020).

To comply with the BREEAM certificate the development consortium is obliged to publish about the sustainability measures in the building. This document is more updated than the bidbook and shows how the design has become more specific over time. The recycled bricks in the façade are mentioned here, but the construction behind the bricks is now further designed as a timber frame construction. In this publication circularity is described in four key points (AM et al., 2020):

- Adaptable design of the building, the office floors are for example transformable into housing
- Low environmental footprint of materials, for example recycled aluminium, timber frame construction and the recycled bricks in the façade
- Large prefab elements which are dismountable, making it easy for reuse
- The use of solely renewable energy sources and water looping in the building

It is remarkable that the percentages for circular materials which were mentioned in the bidbook are not recurring in this document. The BREEAM score has also been revised to 88%, which is still categorised in a BREEAM outstanding certificate and the building would become the first multifunctional building with this certificate in the Netherlands (AM et al., 2020). It is not exactly ascertainable why these ambitions have lowered during the development process, but from the other cases we see also that not all measures in the proposal seem feasible, leading to a lower ambition level than noted in the tender proposal.

11.6.5 Synthesis Circular tender

In this last paragraph on the Kop Zuidas case a wrap up is made how the policy has affected the building, in the process of the tender. A short conclusion on this case is also given at the end of this paragraph.

The whole process from policy to building contract is shown on the left side in Table 34. The first row of ‘policy on public procurement’ shows the aims where the municipality of Amsterdam uses the tool of public procurement. The following three lines in Table 34 describe the tender request. In the spatial plan for the building envelope the municipality mentions shortly the sustainability goals for the plot (Gemeente Amsterdam, 2017a). In half a page five circular aims pass in the documents. These aims are not directly translated in the tender criteria. A BREEAM score is required, together with a vision on circularity and the question to quantify this vision as much as possible. No specific attention is given to the separate CE aims which were formulated in the policy and the tender vision.

The circularity aims in the building proposal is visualized in the two rows assessing CE in the bidbook in Table 34. It is remarkable that although the different circular aims were not assessed in the tender, almost all the aims can be found in the bidbook. The real estate developer was also capable of quantifying how much materials are looped, how much

electricity is generated on the building, the number of car-sharing-places and how a lighting system leads to less electricity consumption. Quantifying these number can be important to keep the real estate developer on his promises.

Assessing how circularity is ensured in the building contract is a bit more difficult. Essentially the real estate developer is obliged to realise the building equal to his promise in the bidbook (Gemeente Amsterdam, 2017c), but changes in the design occur during the further development process and they can be made from the bidbook (project developer, personal communication, March 3, 2020). Therefore Table 34 shows the aims where a fixed agreement is made between the municipality and the real estate developer. These are the percentage of looped materials, a reuse percentage of 98%, the energy index and the BREEAM score.

Table 35: Circularity aims assessed through the process of Kop Zuidas

Tools \ Aims	Looping	Adapting	Regeneration	Localise	Substitution	Sharing	Optimising	Unspecified
Policy on public procurement	■	■	■	■				■
Aim in municipal tender vision	■	■	■			■	■	
Quantitative criteria in request								■
Qualitative criteria in request								■
Quantitive CE in proposal	■	■			■			
Qualitative CE in proposal	■		■			■	■	
Circularity in contract	■		■					■

Overall Table 34 shows that although not all circular aims were incorporated in the tender criteria the municipality was able to achieve that almost all the aims, except localise, were adopted in the tender proposal. Possibly this is partly achieved because a BREEAM certificate is required, which also touches upon many of circular aims. However, requiring this certificate can make it more difficult for the municipality to steer on the aims specifically.

11.7 Amsterdam: Centrumeiland 14-01

'Centrumeiland' is a new island which is constructed in the IJ-lake in Amsterdam, the island is part of a new neighbourhood consisting of six islands of which Centrumeiland is the largest. 'Kavel 14-01' (Plot 14-01) is the entrance building of the island. The tender prescribes a building with rental apartments and local facilities on the ground floor. This tender distinguishes itself from the other tenders, and the previous case regarding kop Zuidas because it is the first tender where the circular ground lease policy of the municipality of Amsterdam was introduced.

11.7.1 Municipal policy

The policy is equal to policy for the tender of kop Zuidas, discussed in paragraph 10.6.1.

11.7.2 Tender request

The tender for 'Kavel 14-01' was put into the market as a pioneering tender on the area of circular building. Out of the three pilot tenders for the roadmap circular land tendering, this is the only tender where the policy is explicitly used (sustainability advisor Amsterdam, personal communication, February 18, 2020). The start of the selection phase was in December 2017 and the tender procedure finished in the summer of 2018. Thus, this tender ran just after the tender for Kop Zuidas.

The Municipal project manager ground & development (from now on project manager) explains that the roadmap circular land tendering selected the tender for kavel 14-01 as a pilot project to use this roadmap. Due to of this instruction circularity was strongly anchored in the project (personal communication, March 13, 2020). The roadmap circular land tendering uses five themes for CE tender criteria but incorporating all these five themes was not found to be feasible in a tender. A selection was made for energy because this was also an important aspect in the urban plan, and materials use because this was a preference from the project team (project manager, personal communication, March 13, 2020).

The tender request set up is similar to the tender request of Kop Zuidas, in two staged tender a winner is selected for the building rights of the plot. The other plots on Centrumeiland consist mainly of self-construct dwellings, which are owner occupied. The municipality wants to add rental houses on centrumeiland with this tender. Because the building is located at the entrance of the island, architectural quality is used as one of the main selection criteria, together with circularity to realise the sustainability ambitions the municipality has for the island (Gemeente Amsterdam, 2017f).

The 'building envelope kavel 14-01 Centrumeiland' document gives conditions for the design of the tender proposals (Gemeente Amsterdam, 2017b). The document describes that circularity is part of the tender criteria and states that proposals are challenged to move beyond the existing norms of sustainability by the means of a vision regarding circularity. In this vision technical specifications are assessed as well as the aesthetic value of sustainability measures in the architectural design (Gemeente Amsterdam, 2017b). Additionally, the document describes the goals of the municipality regarding a rainproof and energy neutral island and the requirements of the urban plan. These goals are further elaborated in the tender brochure which was drawn up. Table 31 lists all the formulated goals from the building envelope and tender brochure, together with the interpretation of the circular aim. The project manager states that an energy neutral neighbourhood and material looping cycles were the most important ambitions by the project team which should be realised with the tender (Personal communication, March 13, 2020).

Table 36: CE goals Kavel 14-01 vision categorised as circular aims

Goals		Aim
Rainproof	Plots can process 60L water per m^2 per hour, by water storage, reuse, or infiltration	Unspecified
Energy neutral area	All energy is produced locally	Localise
	Use of renewable energy	Regeneration
	EPC of 0,15	Regeneration/ Optimising
Circular building	Move beyond existing norms	Unspecified
	Challenge to minimise environmental impact of materials over life cycle	Looping / Substitution

In the selection phase of the tender the tenderers were assessed based on two criteria, with each two sub-criteria (Gemeente Amsterdam, 2017f):

Circularity	Vision	15 %
	Reference projects	10 %
Architectural quality	Vision	40%
	Reference projects	10 %

The vision on circularity should focus on two aspects: first a general vision of the tenderers on circular building, which scores higher the more specified and ambitious the vision is. Secondly tenderers should specify which materials they want to use in the design and state why these materials are circular. Tenderers should also specify the percentage of materials which is renewable and which percentage can be recycled after use, the higher the percentage and the more plausible these percentages can be made the higher the score in the tender. Although tenderers had to specify these criteria they have not been used further on in the tender process, and the municipality steered on the tenderers with other criteria (Project manager, personal communication, March 13, 2020). The reference project regarding circularity were optional but could earn the tenderers 10 points on the total of 100 points if references were assessed as successful relevant projects. During the process communication with the market was found important, to understand if the tender request was a reasonable question. This was done by market consultations, which were also done when the policy was formulated, and dialogue sessions during tendering (Gemeente Amsterdam, 2016a; Gemeente Amsterdam, 2017f; Project manager, personal communication, March 13, 2020).

Three tenderers were selected for the awarding phase. In the selection phase there were three main criteria, out of which circularity was subdivided in three sub-criteria (Gemeente Amsterdam, 2017f):

Circularity	GPR score	15 %
	MPG score	15 %
	Explanation	10 %
Architectural quality	Design & explanation	40%
Price	Price	20 %

Out of the circularity criteria the GPR-Score (sustainability performance) and the MPG-sore (Environmental performance score) are both quantitative scoring methods to score circularity. The explanation has a maximum of 8 pages and is an elaboration of the vision which was submitted in the selection phase. In this explanation tenderers were supposed to show how circularity was adopted in the buildings design, to ensure an integration of circularity and architectural quality. These quantitative and qualitative criteria could not be directly derived from the circular policy, for example the roadmap circular land tendering, but were formulated by the project team. With a team including two external advisors for circularity possible criteria were formulated. The project management team

of the municipality made the final choice for these criteria because they are enforceable during the construction phase and developers are able to provide sufficient information for these criteria in the tender phase (project manager, personal communication, March 13, 2020). All tender criteria are listed in Table 36, where they are also interpreted under one of the circular aims.

Table 37: CE criteria Kavel 14-01 request categorised as circular aims

Criteria		Type	Aim
Circularity selection phase:	Vision circular building	Qualitative	Unspecified
	Specify the used materials	Qualitative	Unspecified
	Share of renewable materials + substantiation of likelihood	Quantitative / qualitative	Substitution
	Share of materials recycled after use + substantiation of likelihood	Quantitative / qualitative	Looping
Circularity awarding phase	GPR score	Quantitative	Unspecified
	MPG score	Quantitative	Looping / Substitution
		Qualitative	Adaptability

The tender proposals were assessed in three different jury's, there was a general assessment committee with two project managers who were responsible for the tender on behalf on the municipality. The criteria regarding circularity were assessed by an urban planner, two advisors regarding sustainability and CE. The criteria regarding architectural quality were assessed by three people with different architectural disciplines (Gemeente Amsterdam, 2017f). These different teams were implemented to prevent that a proposal scoring high on one criteria would be overruled by other criteria, for example an enthusiastic jury regarding circularity who would overrule the architects to assess the building also higher for architectural quality (project manager, personal communication, March 13, 2020).

11.7.3 Tender proposal

The tender request was won by the consortium of developer 'building for life' with their plan 'Juf Nienke' (Teacher Nienke). It was not possible to get any information from the developer concerning this plan, but one of the other tenderers did provide information regarding the motives and means to participate in the tender. Therefore, not the wining plan is discussed in this case description.

The proposal for the building 'Cirkelstad' is based on the ecologic footprint of its citizens, which should be no more than 4.2 acre, the equivalent of what every human has on earth compared to the 15.6 acres which is currently used by Dutch citizens on average. The motivation to participate was based on the circular criteria in the request, added with the location which already was of interest with the project developer (personal communication, March 24, 2020). The project developer gathered a project team of different disciplines from different companies to formulate the tender proposal. This project team consisted of an architect, sustainability advisor and contractor and all of them wanted to learn from designing and building a circular building, which was a motivation to participate. Also, the circular criteria were the reason to involve a sustainability advisor, not necessarily because the other team members did not have sufficient knowledge on the theme but because this was an important theme in the tender extra capacity for thinking and reflecting on the ideas was desirable (Project developer, personal communication, March 24. 2020).

The developer did not have a circular vision when the proposal was written, apart from one page at their website. Therefore, the circular measures were formulated specifically for this project. This was done in brainstorm sessions with the project team on how circularity could be integrated within the project. The project developer mentions this was an unstructured process. It was known that the municipality of Amsterdam has a broad vision on sustainability issues, consequently the circularity measures were also interpreted in a broad sense in the tender proposal (personal communication, March 24, 2020).

The circular measures which are presented in the bidbook derive from a brainstorm with the project team and are based on the seven characteristics of a circular economy of Eva Gladek (Mecanoo, Fakton, Traject, BAM, Next City, 2018). These seven principles are also the starting point of the roadmap circular economy. These are specified with some specific measures which are shown in Table 37 and interpreted in the CE aims.

Table 38: CE measures Kavel 14-01 proposal categorised as circular aims

Measures		Type	Aim
Materials	Material passport	Qualitative	Unspecified
	100 % dismountable	Quantitative	Looping
	Reusable & recyclable	Qualitative	Looping
Energy	High thermal insulation	Qualitative	Optimising
	PV-panels	Qualitative	Regeneration
	Central battery	Qualitative	Optimising
	Smart mobility	Qualitative	Unspecified
Water	Rainproof	Qualitative	Unspecified
	Water saving sanitation	Qualitative	Optimising
	Water buffer	Qualitative	Optimising
Biodiversity	Local vegetation on roof	Qualitative	Regeneration
	Greenhouse in courtyard	Qualitative	Regeneration
Operation	Co-working, common areas	Qualitative	Sharing
	Space for exercising	Qualitative	Unspecified
	Circular material depot	Qualitative	Looping

The CE measures were the result of the brainstorm by the team, with an elaboration of the architect. The composition of the team had a large effect on the measures which were taken. The architect had for example experience with dismountable buildings and the contractor had experience with aluminium window frames, which were found easier to recycle than wooden window frames. Because of these experiences the design choice was made to work with recyclable materials instead of renewable materials such as wood. Additionally, the project developer mentioned three factors impacting the circularity measures: the building envelope, the fixed ground price and the long time span between tendering and construction. The building envelope in this tender was found to be quite strict, for example with a gangway to the courtyard of the building block. This strictness makes it more difficult to build with standardised, modular elements which are generally more adaptable, easier recyclable and cheaper. That the fixed ground lease price in the tender can make it more difficult to integrate circular measures due to the higher uncertainty of relatively innovative circularity measures. This uncertainty was also a problem in the time span between tendering and construction, for example the search to a donor building to find materials for the construction is more difficult if the construction is in a few years (Personal communication, March 23, 2020).

11.7.4 Building contract

The tender proposal which is discussed is not the proposal which has won the tender; therefore, it is not possible to compare how the measures from the proposal are adopted

in the contract. The concept contract was added as an appendix in the tender request (Gemeente Amsterdam, 2017e). This concept contract does not mention any specific regulations regarding sustainability or circularity, but the designs should meet the requirements from the building envelope, the final tender proposal and the land-use-plan and all other applicable legislation.

The project manager from the municipality states that the tender proposal from the winning tenderer is an appendix in the contract and the tenderer is obliged to build what has been promised. On the other hand, there is an understanding that the proposal was only a preliminary design, which must be further elaborated. She mentions that the MPG and GPR score, which were also criteria in the tender, are hard numbers which should be realised. Then some measures can be changed during the development process, but the final score must be the same. The project manager also mentions that this can be difficult for the municipality, which has also an interest in building the project. With the housing shortage in Amsterdam and you do not want the neighbours to live on a building site for many years there is an incentive to finalize the project within the planned time (Personal communication, March 13, 2020).

11.7.5 Synthesis circular tender

In Table 38 the process from policy to contract is visualised for the tender of Kavel 14-01. Because not the winning proposal was assessed it is not possible to assess if the municipality got what they wanted in their policy, however the table does show how the proposal responded on the tender criteria.

The policy in this tender is equal to the policy for the tender of Kop Zuidas, with the addition that the roadmap circular land tendering is now explicitly incorporated. Not all aims of the policy are incorporated in the tender criteria. The project team chose for a focus on looping and regeneration because these are stated as focus areas for the neighbourhood and due to personal preferences. The limited vision from the municipality regarding the tender request lead to a new process of vision forming in the project team formulating the tender proposal. The proposal was explicitly formulated on a wider range of aims because that was known to be preference of the Amsterdam municipality (Project developer, personal communication, March 23, 2020).

Although the tenderer did incorporate the seven characteristics of a circular economy in their proposal, which are also the foundation of the roadmap circular land tendering, the aims of adapting and localise did not reoccur in the tender proposal. If the municipality wants to achieve more from these goals with their tender policy, such as it is currently stated within their policy, the aims should be more clearly specified in tenders.

Table 39: Circularity aims assessed through the process of Kop Kavel 14-01

Tools \ Aims	Looping	Adapting	Regeneration	Localise	Substitution	Sharing	Optimising	Unspecified
Policy on public procurement	■	■	■	■				■
Aim in municipal tender vision								■
Quantitative criteria in request	■		■					
Qualitative criteria in request								■
Quantitive CE in proposal	■							
Qualitative CE in proposal	■		■			■	■	
Circularity in contract	■		■					■

Circularity was strongly incorporated in the tender criteria for Kavel 14-01. These criteria were deliberately chosen by the municipality, but not explicitly communicated in the tender vision apart from the criteria. Tenderers do closely watch the criteria because these are the aspects where they can score points. However, it is questionable if the municipality could have achieved more if their vision behind the criteria was more clearly communicated.

11.8 Rotterdam: Delftseplein

Delftseplein is the plot adjacent to the Rotterdam central train station, in the Rotterdam central business district. Within this district various developments are planned by the municipality and the municipality wrote a vision on how the tender for Delftseplein should function within this area development (Gemeente Rotterdam, 2017). The tender was run in 2019 for a building programme of 41.000 m^2 which is supposed to consist of housing and offices with the possibility of a hotel. Additionally, the municipality wants to challenge the tenderers to think of functions which are shared by the users of the building.

11.8.1 Municipal policy

The initiation of CE policy in Rotterdam was done with the policy 'Rotterdam gaat voor circulair' (Rotterdam aims for circularity) which was adopted by the municipal council in 2017 (Gemeente Rotterdam, 2017b). This document recognises four transition paths towards CE:

- Circular procurement by the municipality
- Circular municipal material chains
- From waste to material
- Circular economy

The extent to which level these pathways are specified varies per pathway. Regarding circular procurement the target is to start with ten pilot projects, have 25% of all tenders in 2020 circular and procure everything in a circular manner in 2030. The second transition path wants to transform the material chains where the municipality is involved to circular material chains. This incorporates all the processes where the municipality is involved, in most cases as a client or contractor, which should be for 80% circular in 2030. This is explained as an increase in the amount of reused materials and a decline in the use of virgin materials. Incorporated in the circular material chains is also a circular soil chain, Rotterdam is thereby the only municipality that incorporates something about the circular use of soil, which is defined as one of the key resources in a city by Williams (2019a). To close material cycles the municipality wants to start actions such as a material marketplace, collect organic waste as soil fertilizer and start pilot projects for a circular forest and a circular area development. The third transition path is 'from waste to materials', which is done by improving a waste collection facility, develop a circular assessment framework for waste and explore the possibilities for recycling waste. Lastly regarding 'circular economy' the municipality wants to encourage entrepreneurs to come with circular solutions by initiating living labs, contribute financially to CE projects and advise entrepreneurs on CE.

A sequence from the 'Rotterdam aims for circularity' policy document was a study by consultancy company Metabolic into the material streams in Rotterdam (Gladek e.a., 2018). This research quantified the material flows and suggested based on the possible municipal influence and the size of the material flows four key-sectors where the municipality should place their focus for the CE transition:

- agri-food and green flows
- construction
- consumer goods
- healthcare.

On a broader scale a study is done by research bureau 'DRIFT' in the report 'nieuwe energie voor Rotterdam' (New energy for Rotterdam). This report describes the role of the municipality regarding multiple sustainability issues, such as renewable energy, circular economy, and climate adaptation (van Raak, Spork, Buchel, & Loorbach, 2018). The two research reports both do suggestions on measures the municipality can take, but these are not formally adopted as policy. However, the research reports have influenced the actions of civil servants (Advisor transitions, personal communication, March 19, 2020).

Additionally, the municipal council changed in 2018 and in the new coalition sustainability became higher on the agenda, the coalition agreement has for example the same name as the study by DRIFT and adopts a number of the measures from the study report (Advisor transitions, personal communication, March 1, 2020). Later in 2019 more sustainability policies were formally adopted in Rotterdam, but these were not yet available in the form of policy when the tender for Delftseplein was formulated.

It can be assumed the sustainability policies which were published later in 2019 were drawn up partly parallel with the tender for Delftseplein. For example, the policy is 'Van zooi naar mooi' (from mess to beauty) is published one month after the tender request was published. 'Van zooi naar mooi' is a follow-up from the study by consultancy company Metabolic. This policy has a focus point on looping waste to new materials (Gemeente Rotterdam, 2019b). The policy adapts the four key-sectors of the research by Gladek et al. (2018) out of which the construction sector is chosen as the most important one. Per sector actions are defined which will be undertaken by the municipality. For the construction sector the actions are:

- Material passport
- Circular concrete covenant
- extend construction hubs
- Digital marketplace for construction materials

These actions are all aiming to create more looping actions in Rotterdam. Firstly, the action of material passports wants to log the characteristics of materials to make it easier to reuse them at the end of a building's lifetime. Secondly, the circular concrete covenant aims to recycle more construction & demolition is a covenant to cooperate with other municipalities, ministries, and other partners to achieve the goal of more recycled building waste. In the case of a construction hub, Rotterdam already has a hub since the 1990's, but further applications for the circular economy are studied to reuse more of the building materials at the construction hub. The fourth action further elaborates on these construction hubs by digitalizing information on the materials, to make the materials better accessible for parties who can use the materials (Gemeente Rotterdam, 2019b).

Concluding, Rotterdam has circular policy and has formulated goals specific for their procurement. Additionally, there is policy regarding circular construction. But these two are not combined into a target or aim to incorporate circularity in land tendering.

11.8.2 Tender request

The process for a tender on the Delftseplein in Rotterdam has started long before the tender was asked out in the market, first it was delayed because of the economic crisis from 2008 – 2011. After the crisis had passed the process had restarted, but no sustainability goals were adopted in the tender request. A civil servant who is a strategic advisor on transitions, such as the energy transition, the circular transition, the mobility transition, became aware of the lack of sustainability criteria and went to the director of area developments. With back support of this director the tender process was started over again to incorporate sustainability criteria in the tender, with the civil servant involved as sustainability advisor in the project team. The civil servant mentions that making a difference on sustainability in these tender processes is easier compared to other projects because it still has a low political profile. It will take some years before the building will be built, making in relatively unseen for the Alderman. This process has started around 2016 and this is the process which is discussed regarding this tender request (Personal communication, March 19, 2020).

In 2019 the tender request was put out in the market in the form of a two-stage tender. This was done with an ambition document of the municipality explaining how they saw the

future of the plot, additionally there was a formal process letter which describes the formal aspects of the tender. The ambition document of the tender has a chapter addressing the sustainability ambition which addresses renewable energy, water management and circularity. Regarding circularity this is split into three themes (Gemeente Rotterdam, 2017a):

- Design for life expectancy; Think about the adaptability of a building so it is easy to change functions.
- Design for substantiated sources and destination of materials; maximise reuse of materials and gain insight in material footprint in not only during the construction cycle, but also in the future material cycles.
- Use of material passport; Support the first two ambitions.

Additionally, to these three aspects under circular building the other themes in the sustainability state that the building should be energy neutral, with a limited energy use and locally produced energy. The building should collect rainwater and prevent a spill of drinking water. The chapter about the programme of the building speaks of an ambition on sharing facilities and sharing mobility with the users of the building.

The sustainability ambitions were partly derived from the ambitions of the larger urban area development, but mainly developed by the project team responsible for the tender request. The sustainability advisor of the project team describes for example to have read about material passports as a good solution for circular buildings and is able to incorporate this in the tender (personal communication, March 19, 2020). All the CE aims which are defined in the ambition document by the municipality are listed in Table 31, subsequently these ambitions are categorised under the seven circular aims, which is shown in the last column of Table 31.

Table 40: CE goals Delftseplein vision categorised as circular aims

Goals		Aim
Design for life expectancy	Easy to change functions	Adapting
Design for substantiated sources	Maximise reuse of materials	Looping
	Gain insight in material footprint	Optimising
Use of material passports		Looping
Limiting energy use		Optimising
Energy neutral building		Regeneration
Collecting rainwater		regeneration
Saving drink water		Optimising
Shared facilities & mobility		Sharing

Next to the ambition document of the municipality there is the formal procedure of the tender, this was described by a process letter of the municipality (Gemeente Rotterdam, 2019a). To enter the selection phase tenderers are required to submit two to four reference projects of at least 20.000m^2 at an inner-city location. These are not specific assessed on their sustainable or circular aspects. In this phase tenderers did not have the opportunity to present their plans, but tenderers who were selected into the awarding phase had a dialogue with the tender committee. However, a concept agenda for these sessions is presented by the municipality where sustainability or circularity is not part of. If tenderers do want to address their sustainability concept in the dialogue sessions, they can notify the municipality, but the municipality must agree with a change of the agenda (Gemeente Rotterdam, 2019a). The absence of a market dialogue prior to the tender was also because already many parties tried to pitch their plans for the plot to the municipality and the municipality did not find it necessary to organize another dialogue session (sustainability advisor, personal communication, March 19, 2020). The selection in this phase was done based on four criteria (Gemeente Rotterdam, 2019a):

Spatial vision	20 %
Conceptual vision and mix of programme	30%
Sustainability	30 %
Collaboration partner	15 %

The weight in the criteria for sustainability is extraordinary for Rotterdam because in most tenders from the municipality sustainability weights around 10%. This was partly possible because the tender process was repeated to incorporate sustainability criteria, the sustainability advisor had back support from the director who had added him to the team (personal communication, March 19, 2020).

To score on the criterion of sustainability in the selection phase the tenderers had to write a vision regarding sustainability which involved at least the four ambitions of the municipality: future proof, circularity, the energy concept, mobility and the building method. Hereby the proposals should answer the following questions criteria (Gemeente Rotterdam, 2019a):

- What integral and coherent sustainability concept in which the themes are named is the tenderer proposing and why?
- How will the tenderer deal with separate waste collection and other material streams at the plot?
- What is the mobility concept regarding the objectives of the municipal parking policy (car and bicycle) and the city deal on electric sharing mobility?

In the awarding phase the weight of the criteria is (Gemeente Rotterdam, 2019a):

Spatial & functional design	40 %
Sustainability	20%
Collaboration partner	10 %
Financial bid with substantiation	30 %

The sustainability criterion is assessed based on three aspects:

- A minimum of a BREEAM Excellent certificate, and how this certificate is achieved
- The extent of concreteness and realistically elaborating the mobility transition in the proposal
- The future proofness of the building, among others the flexibility of the building to adapt to future changes in demand

Circularity is mainly assessed in the first aspect of the three listed aspects, based on how the BREEAM certificate is achieved. This criterion was created by a team of 10 engineers from the engineering department of the municipality of Rotterdam. Each of the engineers had a different expertise of sustainability and together in the team an extensive list of possible sustainability criteria for the tender were formulated. A similarity with BREEAM criteria was found between this list. Due to the fact that BREEAM criteria are well known in the construction sector it was decided to incorporate the list as BREEAM criteria (sustainability advisor, personal communication, March 19, 2020). A list of 40 BREEAM criteria is added to the ambition document of the municipality where they want the developers to score (Gemeente Rotterdam, 2017a). There was a focus on these 40 criteria instead of all the BREEAM criteria to give a focus of the ambitions of the municipality. The sustainability advisor states that it would be quite easy to achieve the BREEAM Excellent certificate because this also incorporates aspects of the accessibility of the plot. With a location next to a train station it would be easy to score on these points. Instead the municipality wanted the tenderers to focus on other points which they identified as challenges (personal communication, March 19, 2020).

The tender criteria regarding CE are listed in Table 32 together with their type, qualitative or quantitative and the circular aim they represent. From the table it becomes clear that

the municipality is mainly requesting a vision from the tenderers on the building, but the municipality specification of which circular aims should be included is very limited. Future proofness has been defined by the municipality as the adaptability of the building to adapt to changes in demand and can therefore also be categorized under the aim of adaptability. Tenderers should provide a vision on circularity, the energy concept, and building method, but are free to address different aims in these aspects. Regarding mobility the aim of mobility sharing is explicitly addressed. In the second phase the municipality demands a further elaboration on some of these aspects but does again not directly specify which aims should be addressed. A BREEAM certificate, with corresponding score, is the only quantitative aspect requested by the municipality. Overall, the municipality gives a lot of freedom to the tenderers to fill in the criteria how they prefer, where the municipality assesses these in a qualitative manner. The municipality requests tenderers to elaborate in their vision on some themes, such as circularity, but does not specify how this should be done in the criteria. However, this is more clearly specified in the tender ambition document of the municipality, which is likely to be addressed by the tenderers as well.

Criteria		Type	Aim
Sustainability vision selection phase:	Future proof	Qualitative	Adaptability
	Circularity	Qualitative	Unspecified
	The energy concept	Qualitative	Unspecified
	Mobility (sharing)	Qualitative	Sharing
	Building method	Qualitative	Unspecified
Sustainability awarding phase	BREEAM excellent	Quantitative	Unspecified
	Mobility transition	Qualitative	Unspecified
	Future proofness	Qualitative	Adaptability

Table 41: CE criteria Delftseplein request categorised as circular aims

11.8.3 Tender proposal

The tender for Delftseplein was won by the tender proposal for the building 'Treehouse', a 140-meter-tall tower with a hybrid construction made from wood with a concrete core. The building consists of 275 houses and 15.000 m^2 commercial floor area. With the building the architect aims to design a building at the forefront of architectural sustainability with the sustainability measures taken in the building (PLP Architecture, n.d.).

The tender request by the municipality was very positively received by the project developer, who was mainly happy about the 40 BREEAM criteria which were selected by the municipality as selection criterion. This made clear what the ambitions of the municipality were, and the team working on the proposal could think how these aspects could be integrated. A consultancy company was asked how the sustainability criteria could be integrated in the building, the selection made by the municipality was their framework to develop the sustainable measures (Project developer, personal communication, March 26, 2020).

The bidbook of the tender proposal mentions several sustainability measures in the building. It is calculated the building retains 3.474 tonnes of CO_2, which is encapsulated in the wood which is used in the building (Provast, 2019). Although this has a high impact on the total carbon footprint of the building, the project developer states that the main reason to build with wood was not for sustainability reasons. This was mainly done to make a statement towards the municipality in the centre of the city. The sustainable specifications of the wooden construction were a nice added value which could be used in the tender (Project developer, personal communication, March 26, 2020). The bidbook mentions the origin of the wood together with a certification for good forestry, hereby the

bidbook gives an answer to the tender request where the origin of materials was found important.

The building also aims to reuse materials from existing building. Because circularity had to be included in the tender proposal of the tenderer the project developer mentions that a search was started towards a donor building (personal communication, March 26, 2020). This building was found and in the bidbook a study has already been done on the materials which are available in the donor building, but a direct application is not directly mentioned. Additionally, the bidbook mentions that wood from a neighbouring plot can be reused in the finishing layer of the walls. All materials will also be registered in a material passport so they can be recycled at the end of the lifetime of the building (Provast, 2019). During the construction phase a study will be conducted on which recycled materials are at that moment available for the finishing of the building. In total 80% of the materials which will be used in the building must be verifiable responsible (Project developer, personal communication, March 26, 2020).

Adaptability was a clear aim in the tender request and is also adopted in the tender proposal. This is mainly translated into flexible office areas, which can grow or shrink depending on the demand from the business (Provast, 2019). Additionally, the floor-to-ceiling height is higher than normal, making it more flexible to change the use of the building (Project developer, personal communication, March 26, 2020).

It was not possible to study the entire bidbook, and only the parts about adaptability and material looping were provided by the project developer. Additionally, the website by the architect also mentions that the building contributes to rainwater collection and greenery in rooftop greenhouses re-establishes an eco-system (PLP architecture, n.d.). Apart from the bidbook the developer is currently looking towards extra sustainability measures to increase the BREEAM score and achieve a higher label, which is not steered from the municipality but the initiative of the developer (project developer, personal communication, March 26, 2020).

The project developer mentions that almost all the tenders in which they participate circularity is part of the assessment, the tender proposal is not radically different compared to these other tenders. In most cases the developer relies on a BREEAM certificate or BENG requirements because these give guidelines and we think we can provide a good added value when we work along the guidelines (Project developer, personal communication, March 26, 2020).

Table 42: CE measures Delftseplein proposal categorised as circular aims

Measures	Type	Aim
Building with wood (3.474 tonnes of CO_2 encapsulated)	Quantitative	Substitution
Donor building for materials	Qualitative	Looping
Material passport	Qualitative	Looping
80% of materials verifiable responsible	Quantitative	Substitution
Flexible office space	Qualitative	Adapting
Eco-system in greenhouses	Qualitative	Regeneration
BREEAM Excellent certificate	Quantitative	Undefined

All the measures regarding CE are listed in Table 33 and interpreted against the seven circular aims. The three circular themes which are mentioned by the municipality in the ambition document (design for life expectancy, design for substantiated sources & destination and, material passports) are recognisable in the tender proposal. Adaptability, or design for life expectancy, is integrated as a chapter in the bidbook, a promise is made

for 80% of the materials which is verifiable substantiated, and the building will use a material passport. From this it can be concluded that the tenderer has studied the main themes in the tender and formulated an exact response to these themes. Additionally, the measures are mainly on a qualitative level, so the qualitative criteria have led to qualitative responses from the project developer.

11.8.4 Building contract

The building contract has not been checked with the tender commission, and thereby the municipal advisor responsible for sustainability (personal communication, March 19,2020). This might suggest that a standard contract is used, where circularity, or sustainability in general, is not strongly in incorporated. The project developer mentions that circularity is mainly documented in the bidbook by the developer and the tender guidelines by the municipality, the request, and the proposal, which are both part of the contract. The project developer mentions that it is possible to deviate from the bidbook during the development process, but this requires a substantiated reason why the initial plan is not feasible (personal communication, March 26, 2020). An exception to this rule of deviation is for example the BREEAM Excellent certificate, which was part of the tender requirements by the municipality. This is a hard norm which must be met by the tenderer.

11.8.5 Synthesis circular tender

Rotterdam has CE policy, of which a part was available when the tender request was drawn up. The policy is mainly focused on recycling materials and the production of renewable energy. However, the department for city management is responsible for this policy, which made that the implications are mainly focussed towards the responsibilities of this department. This made that when the tender was drawn up there was no policy directly available which could be implemented in the tender. Therefore, when the tender was drawn up a team of 10 engineers was put together to come up with criteria for circular building. In Table 42 it is visualized how some of the aims reoccur in different steps of the tender process, for example the aim of looping is present in policy on public procurement, it is an aim in the municipal vision document for Delftseplein and it is mentioned in a qualitative way in the tender proposal. This indicates a successful link between the municipal policy and the tender proposal, however in the municipal vision the concept of looping had to be redefined apart from the policy on procurement. A stronger connection between policy and realisation can be possible when the policy is better fitting to what can be requested in a tender.

Secondly, Table 42 shows that the tender proposal answers mainly in a qualitative manner, responding to the mainly qualitative criteria. The amount of CO_2 captured in the building is made quantitative and a BREEAM score. The last one is a requirement made by the municipality, the first one is quantified out of initiative by the tenderer.

Table 43: Circularity aims assessed through the process of Delftseplein

Tools \ Aims	Looping	Adapting	Regeneration	Localise	Substitution	Sharing	Optimising	Unspecified
Policy on public procurement	■	■		■				
Aim in municipal tender vision	■	■				■	■	
Quantitative criteria in request								■
Qualitative criteria in request		■				■		■
Quantitive CE in proposal					■			
Qualitative CE in proposal	■	■	■					
Circularity in contract								■

Overall, the municipality chose three circularity goals in this tender, design for life expectancy, design for substantiated sources & destination and, material passports. These three aims are clearly translated by the tenderer in their design. Apart from the framework in Table 42 it can therefore be concluded that the municipal tender goals were successfully achieved, however these goals cannot be directly translated into the framework of CE aims. Distinguishing a better relationship between circular policy and tender requests can further improve municipal tenders, so tender proposals will further contribute to realising the municipal policy goals.

11.9 Utrecht: HUQ

The Healthy Urban Quartier (HUQ) in Utrecht is part of the 'Beurskwartier' or 'Stationsgebied', an area development next to the central station in Utrecht. The plans for this are developed in 2016 and the tender for HUQ was the first project in the area. A central aspect in the visions is the growing number of travellers from the train station, and the growing city of Utrecht. The new station area should connect the city areas on both sides of the train station.

The tender for the Healthy Urban Quartier (HUQ) in Utrecht was held in 2016 to 2017 and a special website was launched to inform all tenderers (HUQUtrecht, 2016). The project has a maximum floor area of 70.000 m^2 which could be filled with functions such as housing, commercial and cultural functions. This tender is the only one of the four case studies which is run in a non-public tender procedure, but this mainly relates to the judging by the selection committee.

11.9.1 Municipal Policy

In 1993 the municipality of Utrecht adopted a sustainable building bill (kadernota duurzaam bouwen), which already addresses that the building sector has a share of over 20% of the total waste production. To overcome this, the bill formulates looping material streams as focus point (Giorgi, 1993). This policy was officially still effective during the tender in 2016, however because it was over 20 years old it did not have much influence anymore (Developer circular economy, personal communication, March 20, 2020).

To understand the policy behind the tender for HUQ it is important to understand that it is part of larger urban area development of Beurskwartier, HUQ was the first project which was initiated in this area. The municipality had drawn up development visions regarding the whole area, these development visions have been included in the tender request for HUQ and are therefore also considered as municipal policy regarding the project. This policy started with a masterplan for the station area, which was based on the preferences indicated by the citizens in a referendum (Gemeente Utrecht, 2003). The masterplan mainly discusses the building density, functions and public space, the themes of circularity and sustainability are not discussed. (Gemeente Utrecht, 2003). A 'structure plan' is the further elaboration of the masterplan. This structure plan designates several green areas within the urban development and initiates the ambition that the area should absorb all the rainwater which falls in the area (Gemeente Utrecht, 2006). Apart from these two the plan elaborates on the air quality in the area, which should be improved by limiting polluting traffic (Gemeente Utrecht, 2006). Additional to the development plans a CE vision for the neighbourhood was drawn up as part of a living lab in the area (Marco.Broekman & LINT, 2017). This vision states that recycling loops should be approached at different scale levels, giving a priority for food waste, water and some construction waste at the neighbourhood level. To further implement the recycling of construction waste in the area development a material scan was done, to study the materials which will come available in the area due to the demolition of old buildings, and how these can be looped into the construction of the new buildings (Hofman & Rens, 2018). On a larger scale the municipality of Utrecht collaborates in an alliance with surrounding municipalities and regional authorities to stimulate CE in the region. This is instead of a municipal vision regarding circularity, which is not available in Utrecht. This regional collaboration: 'cirkelregio Utrecht' has policy and programmes to reach. The cirkelregio has a strategy to prepare and implement circularity in the construction sector, for example by using the tool of public procurement (Cramer, 2015).

From 2016 onwards the municipality has added some new CE policy. In response to signing the national material agreement a letter regarding the actions for a CE was sent by the

board of Mayor and Aldermen to the municipal council (Gemeente Utrecht, 2017b). Based on the research done in by the 'cirkelregio Utrecht' the municipality focuses on:

1) Circular procurement
2) Collecting: from waste to material
3) Circular construction and demountability

The letter describes the steps which are taken in these fields. Several pilot projects are organised, for example with circular concrete or low-CO_2 asphalt. The reuse of materials is taken a criterion in several tenders and a community of practice is organised with market parties around the theme circular building. Regarding the focus on circular procurement a new procurement policy is introduced in 2018.

This procurement policy has CE as one of its core values (Gemeente Utrecht, 2018). The concept of 'rethink' if it needs to be procured, or if it can be arranged in a different way is present, together with trying to share the procured goods. Where possible the municipality tries to procure locally as much as possible. Subsequently the policy elaborates on several categories of procured goods, among which real estate and infrastructure are present. Regarding real estate the policy states there is a commitment for futureproof, adaptable buildings which are used for a longer timespan or redeveloped if possible, with the use of reused materials. As more specific guidelines for circular construction GPR and BREEAM certificates are mentioned. For infrastructure the policy states a number of specific examples such as replacing paved surfaces with green areas, reusing pavement materials and a number of pilot projects are mentioned (Gemeente Utrecht, 2018).

In conclusion it can be said that Utrecht has a strong focus on procurement regarding CE. In 2016, when the tender was held, there was a collaboration which recognised the tool of procurement to reach a circular construction sector. After the tender was held policy further developed and now CE is one of the core values of the procurement policy of Utrecht.

11.9.2 Tender request

The tender request for HUQ was launched in 2016 with a website, where the municipal vision on the tender was announced. This tender is the only one of the three which is run in a non-public tender procedure, which means less information of the municipal ambitions and the tender procedure was available to the market and rules regarding tendering are not as strict as formal tender procedures which follow the EU guidelines.

The tender was put out in the market for around 54.000 m^2, and during the development process this has grown due to additional ambitions to 70.000m^2 (project developer, personal communication, March 27, 2020). During the tender the ambitions of the municipality related to the ambitions for the urban area, which had a focus on healthy living. This ambition was also the focus for the tender of HUQ.

The motive to incorporate sustainability criteria in the tender for HUQ was the process which ran parallel on the environmental vision of the area. The aspects of 'Green, healthy, sustainable and innovative' were central in the environmental vision and the municipality wanted to challenge real estate developers how those aspects could also be incorporated in a building. The choice fell on this specific plot because other building plans had failed and there were no other plans. This made it easier to incorporate the aspects in this tender than the other tender were a business case was made for an office building, leading in high revenues for the municipality (Project manager, personal communication, March 6, 2020).

The ambitions regarding the CE are discussed in the vision 'circulair beurskwartier', which was added to the tender documents. The ambitions of this document are therefore used and interpreted as the CE ambitions for the tender (Marco.Broekman & LINT, 2017). The vision starts with four strategies, followed by ten actions for a CE. All the strategies and the

actions on the neighbourhood level are listed in Table 43. Each of these points is subsequently interpreted into one of the seven CE aims. Most of these ambitions are categorised under the aim of looping, but the vision is a broader representation of CE and touches upon five of the seven aims.

Table 44: CE goals HUQ vision categorised as circular aims

Goals		Aim
Test site Beurskwartier	Testing looped materials & recycling	Looping
Landscape as machine	Intensive, hybrid, vertical greenery	Regeneration
The hybrid building block	Flexible & adaptive building blocks	Adapting
	Create common space	Sharing
High streets	Connect local circular facilities	Localise
Minimise litter		Unspecified
Stimulate waste separation		Looping
Reuse demolition waste in new buildings		Looping
Make composting and urban farming initiatives visible		Localise
Designate space for CE facilities (e.g. repair shops, sharing facilities)		Unspecified

When tenderers wanted to enter the tender process, no reference projects were necessary, so there was not made a selection based on experience with circularity, nor could tenderers earn points based on their experience with sustainability or circularity (Gemeente Utrecht, 2016b). Additionally, a market dialogue was not held prior to the tender, but the municipality was assisted by two real estate management companies to help formulate a reasonable tender request. The municipality interpreted this as a form of involving market parties in the formulation of a tender and sees this as an alternative to having a market dialogue prior to the tender (Project manager, personal communication, March 6, 2020).

Tender criteria selection phase (Gemeente Utrecht, 2016b):

Vision on concept, programme & sustainability	65 %	
Spatial vision (architectural)		
Vision on collaboration & participation		
Indicative ground value with substantiation	35 %	(bid: 10% & substantiation 25%)

The weight of the qualitative criteria has never been published or notified to the tenderers. The criteria were weighted qualitative, where the process letter states regarding the vision on concept 'the proposal scores better when the integral concept better suits the ambitions of the Beurskwartier (healthy urban boost), as an example of innovative, healthy, sustainable and green urbanisation.'

There was dynamic between the qualitative criteria, where the project manager states that the tender request had too broad ambitions to be very innovative in a single field, for example circularity (Project manager, personal communication, March 6, 2020).

In the selection phase the number of tenderers was narrowed down to four, these all elaborated their building proposal and were assessed based on the following criteria (Gemeente Utrecht, 2016a; Process manager, personal communication, March 6, 2020):

Spatial vision (design / contribution to healthy, sustainability & green)	75%
Functional quality (mix / attractiveness /plinth)	
Collaboration and participation	
Financial bid	10%
Financial substantiation	15%

Also, in the awarding phase the weight of the qualitative criteria was not published, or notified to the tenderers (Project manager, personal communication, March 6, 2020). The municipality requires tenderers to include in their proposal (Gemeente Utrecht, 2016a):

- The contribution to healthy, sustainable, and green urbanisation (Healthy Urban Boost).
- The energy concept and the way in which it functions and performs (including a specified overview of energy consumption for heating, cooling, and electricity).
- The mobility solution (including parking) and the way it operates.
- The futureproofing of the property.
- The contribution to the circular economy.
- The entrance(s) and accommodation spaces.
- The interaction between the real estate and its environment.
- The flow of users and visitors.
- The logistics / forwarding and the way it functions.

Although some of these requirements requested the tenderers to deliver quantitative information, for example the specified overview of energy consumption, scoring is done only on a qualitative basis. The process letterer lists a few aspects where proposals are better scored when they give a better to solution towards the aspects, among these aspects one is 'the plan is more future-proof and gives a higher contribution to the circular economy'.

The essence of this tender is that the criteria were measured on ambitions and not based on requirements, which was a relatively new method of tendering. This becomes also clear from the tender criteria in Table 44, which is defined on an abstract, qualitative level, the criteria in the two phases are similar, the assessment in the second stage is only based on more details. The goal was to have the best building of the proposals by assessing based on these ambitions. This was for example the reason to exclude BREEAM criteria in the tender because there was an experience with another project where it was too easy to achieve a BREEAM certificate, which did not essentially lead to a better building (Project manager, personal communication, March 6, 2020).

Table 45: CE criteria HUQ request categorised as circular aims

Criteria	Type	Aim
Alignment to the vision 'healthy, sustainable & green	Qualitative	Unspecified
Energy concept The extent of energy neutrality	Qualitative	Regeneration
Mobility solution	Qualitative	Unspecified
Contribution to circular economy	Qualitative	Unspecified

Tender proposals were assessed in four panels, each responsible for one criterion. These panels consisted out of four to eight people. This is the only tender of the studied cases where also external advisors, from consultancy companies or the university, were invited in the assessment panels to get a comprehensive assessment on the criteria. The panels gave an advice to a central assessment committee, this advice was in the first phase more consequential than in the second phase because the central assessment committee found during the tender process that it was more important to have an integral assessment (Project manager, personal communication, March 6, 2020).

11.9.3 Tender proposal

The tender was won by the plan for Wonderwoods, a building which distinguishes itself by the lush greenery on the facades and rooftop. This greenery is the most eye-catching element of the building and a lot attention has gone to designing this. The building consists of two towers, together housing almost 300 apartments and almost 25.000 m^2 of commercial area.

When the tender request was published the real estate developer participated because they wanted to build an iconic building in the city of Utrecht (Project developer, personal communication, March 27, 2020). The development process started with the search of an architect, in the ambition document of the municipality was an image of a building in Milan as reference included. The director of the development company knew the architect of this reference building, therefore the same architect was asked to join the team for the tender and make a similar building (Project developer, personal communication, March 27, 2020). Apart from this architect a project team was put together with another architect and a consultancy firm, both firms were more often collaboration partners of the development company.

The municipal vision for a healthy, sustainable & green area were leading in the development, together with the building concept by the architect. At the same time the developer aimed to answer each document which was provided in the tender request with an answer. This meant that the CE area vision of the municipality was responded to with a CE vision for the building. The municipal CE vision was perceived broad by the developer, which gave room to be creative for CE solutions in the building. This was perceived positive by the project developer, but he sees also a risk of project developers who could cherry-pick on circular measures which cost the least, so they can make the biggest profit on the building (Personal communication, March 27, 2020). During the tender process the municipality requested the developer to further elaborate on the concept of the plants on the façades and roofs, this was done but cost extra money and time from the developer so as a trade off some other aspects could be elaborated with lower detail (project developer, personal communication, March 27, 2020). All the CE measures which were included in the bidbook are listed in Table 45, where they are also interpreted in one of the seven circular aims.

Table 46: CE measures HUQ proposal categorised as circular aims

Measures	Type	Aim
BREEAM Excellent	Quantitative	Unspecified
WELL core & shell gold	Quantitative	Unspecified
Use of S-team to develop most effective new methods	Qualitative	Unspecified
Recycling hub	Qualitative	Looping
Material passport	Qualitative	Looping
Innovative installation concept	Qualitative	Unspecified
Waste separation during use of building	Qualitative	Looping
Energy neutral building	Quantitative	Regeneration

Because this tender was held longer ago than the other tenders, already a bit more can be said about the process which took place after tendering. This was quite an extensive process because many aspects still had to be designed. This was also part of the bidbook, as the developer had promised a sustainability team (S-team) where the tenderer and the municipality would together *apply ''the latest innovative techniques regarding energy, water, health and circularity. It will include a multidisciplinary team of specialists and make use of agile 'Scrum' techniques to organically find and apply the most effective, new methods.''* (G&S Vastgoed & Kondor Wessels Projecten, 2016, pp. 59). In these, and other, sessions with the municipality it was sometimes difficult that a lot of design choices still had to be made. Especially the limited focus in the ambitions of the municipality made it sometimes difficult to make decisions regarding the design. This was sometimes frustrating for the developer when aspects of the plan would be researched based on ideas of the municipality, which later were found not feasible on the side of the municipality. A more

clear focus in the ambition could have prevented this if the municipality knew more clearly what it wanted and what the municipality could do to achieve this (project developer, personal communication, March 27, 2020).

11.9.4 Building contract

In the contract between the municipality and the tenderer circularity was not included and sustainability was only limited included. The bidbook from the tender proposal is added to the contract, along with the jury report. These are assessed in all the formal assessment moments, with a preliminary design, definitive design and building permit phase (project manager, personal communication, March 6, 2020). However, assessing all the criteria can sometimes be difficult, for example with the promise of the S-teams. Because this promise was in nature very qualitative, it is difficult to assess if it has succeeded or not. The project developer admitted that the municipality expected more from this joint elaboration than was originally planned (personal communication, March 27, 2020).

Although the bidbook is added to the contract, it should be seen as a 'gentlemens agreement', the building which will be constructed should be in line with the ambitions in the bidbook, but one should also understand that room for changes is necessary in the development process which follows after the tender is awarded (project developer, personal communication, March 27, 2020). This is for example the case with the sustainability certificates. In the most cases these are defined as 'hard criteria', which must be realised, in this case the municipality and project developer have decided that a WELL core & shell certificate could be relinquished. This was done because the developer had to take extra measures to achieve this certificate. These would be taken at the expense of other measures in the building. In collaboration with the municipality it was decided that the WELL certificate was not necessary anymore, but many of the criteria for a WELL certificate are incorporated in the building. Additionally, there is now for example more mid-range rental in the building than originally planned, which was a desire of the municipality (project developer, personal communication, March 27, 2020).

11.9.5 Synthesis of circular tender

A difference between the tender for HUQ and the other case studies is that the municipality had a vision for the plot on a more abstract level than in the other cases. Table 46 shows how the aims are incorporated through the tender process, which shows that the tender request was barely specified on the specific CE aims. 'Healthy, sustainable & green' was the core message, but this can be very widely interpreted.

Table 47: Circularity aims assessed through the process of HUQ

Tools \ Aims	Looping	Adapting	Regeneration	Localise	Substitution	Sharing	Optimising	Unspecified
Policy on public procurement	■	■	■	■	■		■	
Aim in municipal tender vision								■
Quantitative criteria in request			■					■
Qualitative criteria in request			■					■
Quantitive CE in proposal			■					■
Qualitative CE in proposal	■		■		■	■		■
Circularity in contract								

This abstract, qualitative request from the municipality lead to a proposal which was also more abstract than the proposals in the other case studies. Only the aspects which were requested to be quantified by the municipality, were quantified in the proposal. The qualitative aspect of the tender made it also difficult to incorporate circularity in hard agreements in the contract. Consequently, it is only incorporated as part of the bidbook, which is an appendix to the contract.